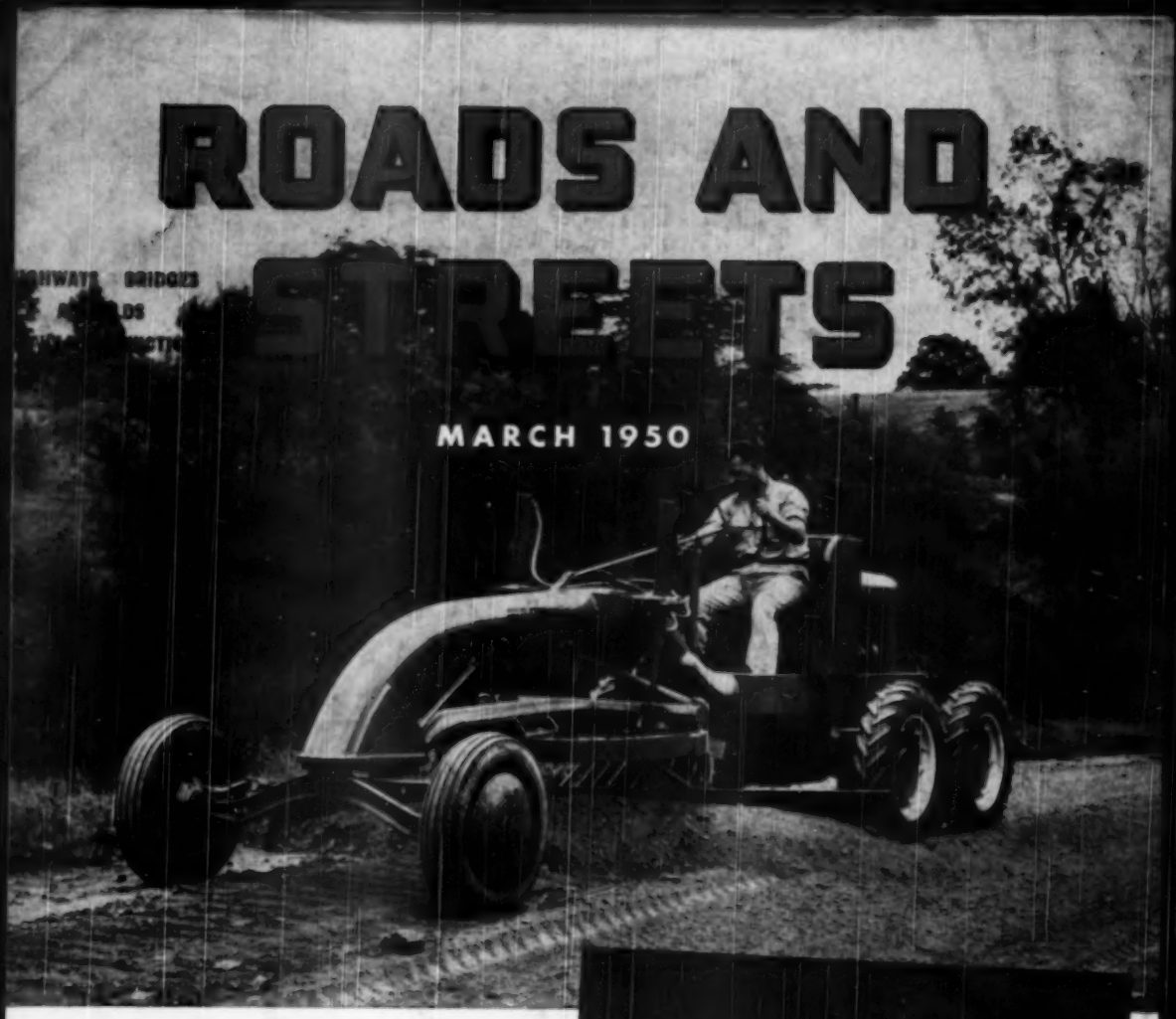


New low-priced grader features tandem drive on TIMKEN® bearings!

THE new Allis-Chalmers model "D" motor grader is a low-priced machine with several big-grader features.

One of these is the tandem rear-wheel drive that gives greater driving power for bigger loads. This drive is mounted on Timken® tapered roller bearings to insure smooth, trouble-free operation, minimum maintenance and long life.

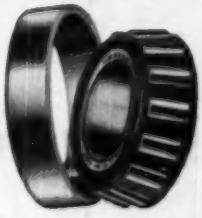
Because Timken bearings have a tapered design, they take radial loads, thrust loads, and combinations of both. Line contact between rolls and races gives them extra load capacity. They're made of special analysis Timken alloy steel—case hardened for extra toughness inside and extra hardness outside.

It pays to make sure the machines you build or buy are Timken bearing equipped. Always look for the trade-mark "Timken" on the bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN

TRADE MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



....with a NORTH

HERE'S a spot where the profits begin—The Batcher Plant! Put the batcher plant "down" because of crane failure and it costs you money out on the grade.

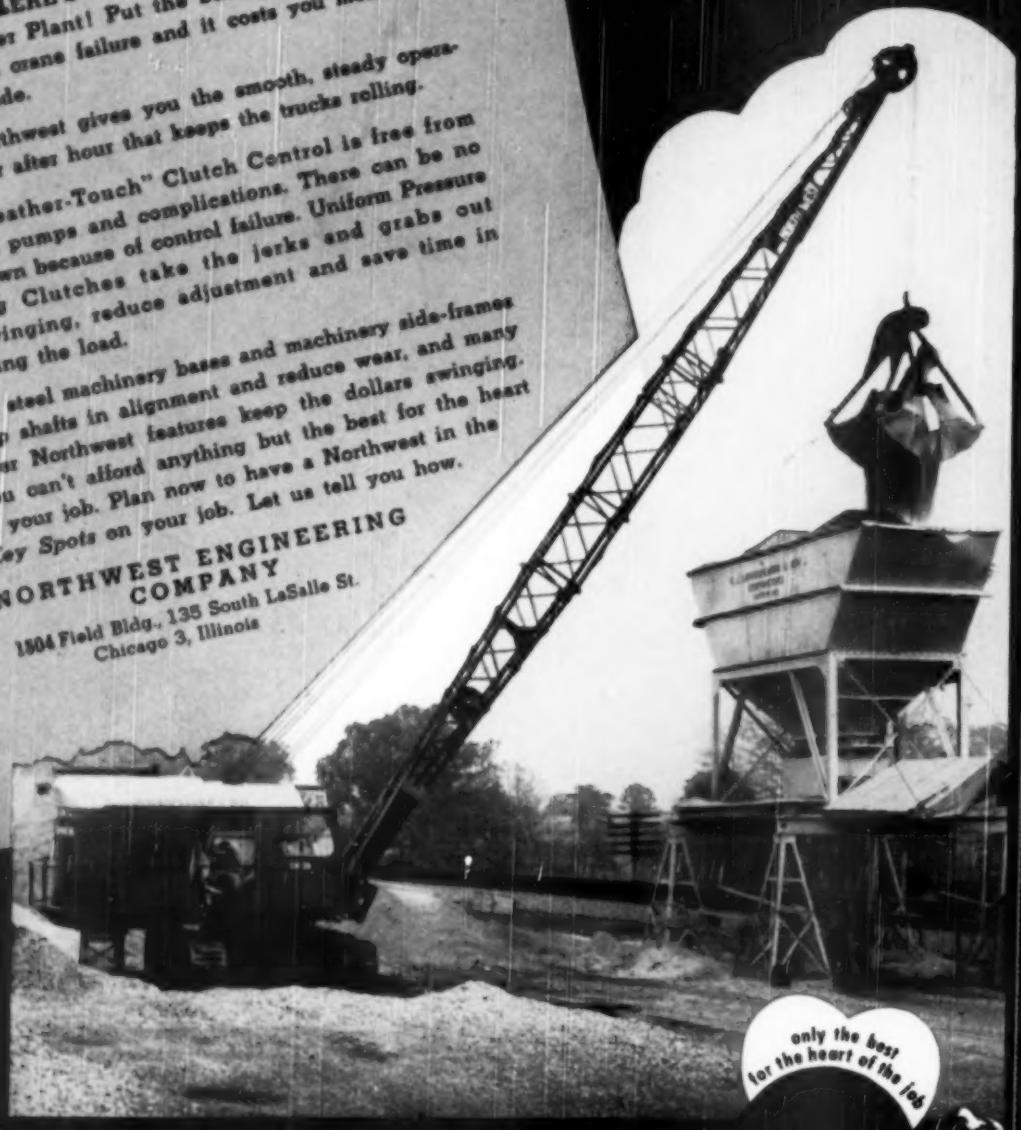
Your Northwest gives you the smooth, steady operation hour after hour that keeps the trucks rolling.

The "Feather-Touch" Clutch Control is free from rubbing, pumps and complications. There can be no shutdown because of control failure. Uniform Pressure Swing Clutches take the jerks and grabs out of swinging, reduce adjustment and save time in spotting the load.

Cast steel machinery bases and machinery side-frames keep shafts in alignment and reduce wear, and many other Northwest features keep the dollars swinging. You can't afford anything but the best for the heart of your job. Plan now to have a Northwest in the Key Spots on your job. Let us tell you how.

NORTHWEST ENGINEERING COMPANY

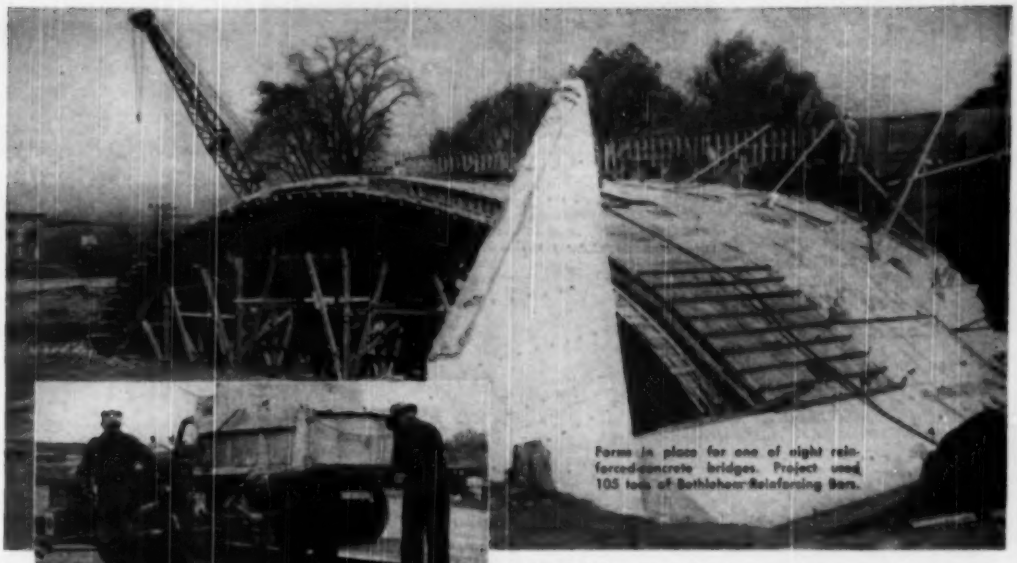
1504 Field Bldg., 135 South LaSalle St.
Chicago 3, Illinois



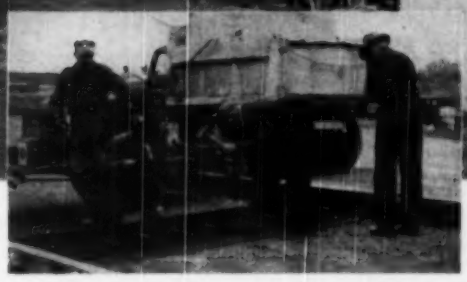
only the best for the heart of the job

NORTHWEST

CRAWLER and TRUCK MOUNTED SHOVELS • CRANES • DRAGLINES • PULLSHOVELS



Forms in place for one of eight reinforced-concrete bridges. Project used 105 tons of Bethlehem Reinforcing Bars.



Staking Bethlehem Dowel Unit in place. Note near-perfect vertical and horizontal alignment of dowels.

Cutting a New Path for U.S.230

To avoid congested areas, U. S. Route 230, heavily-traveled highway between Lancaster, Pa., and Harrisburg, was moved eastward recently in the vicinity of Mt. Joy. The construction photographs shown here were taken on a 25,000-ft section of the new four-lane road, built by John H. Swanger, Inc., Lancaster, Pa. Bridge reinforcing, dowel units, hook bolt dowels and keyway forms were supplied by Bethlehem.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

Top, right: Bethlehem Hook Bolt Dowels fitted into sleeve nuts in keyway. After forms are stripped, other hook bolts engage opposite ends of nuts, tieing slabs together. *Bottom:* Crane, with Bethlehem Wire Rope, at work in batching plant.

STEEL FOR HIGHWAYS

Dowel Units • Reinforcing Bars • Bar Mats • Guard Rail
Guard Rail Posts • Wire Rope and Strand • Pipe
Hollow Drill Steel • Spikes • Bolts and Nuts
Timber Bridge Hardware • Tie-Rods
Sheet- and H-Piling • Fabricated Structural Steel

BETHLEHEM STEEL

Left to right: D. Kohler and F. H. Grittinger, Pa. Dept. of Highways; J. Pfrommer, C. J. Wolf, and J. Feltman, of John H. Swanger, Inc.

ROADS AND STREETS

March, 1950 • Vol. 93 • No. 3

Roads and Streets represents 58 years of continuous publishing in the highway field; combined with Engineering & Contracting and Good Roads Magazines, established in 1892

E. S. GILLETTE, Publisher

ECA

HALBERT P. GILLETTE, Editor-in-Chief

Coming Articles

Meetings

See next issue for report on the American Road Builders' Association meeting in Cincinnati, and on the Associated General Contractors' convention at San Francisco.

Bituminous

How do you like our new "Bituminous Roads and Streets" section? Articles coming: . . . Small city airport, paved with sand-asphalt blade mix . . . How a Minnesota contractor handled 178-mile sealing contract . . . California research in seal coat methods . . . Flexible bituminous base problems in Wisconsin . . . Questions and Answers on tar treated gravel methods.

Grading

More reports on fast-paced earthmoving jobs of 1949. Watch "Knockin' out the Yardage" Department.

Concrete Paving

How one state is tightening up on both design and construction procedures. An airport project where dummy joints were sawed . . . More job details on the Pennsylvania Turnpike extension.

Bridges

A canyon bridged by pivoting two bridge halves into place . . . Labor saving details seen on an eastern city viaduct.

Maintenance

Motor grader operation analyzed . . . County's spring maintenance speeded by modern equipment.

Contractor's Shops

Soon to be published, the first of an interesting pictorial series.

Job and Equipment Ideas

More kinks and hints, as seen by the R & S editors in their travels.

Contractors and the superintendents . . . officials and engineers . . . something for all in each issue of "Roads and Streets". Watch for your next copy. Practical "how it was done" articles invited from readers.

HAROLD J. McKEEVER, Editorial Director

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S. A. Phillips, Field Editor

H. K. Glidden, Contributing Editor

P. V. Jones, Production Editor

In This Issue

"Blowing the Muck"—Example of Maine Swamp Filling Practice 37
By A. R. Curtis, Editor, "The Trail," Maine Good Roads Association

Editorials 39

Sloping Curb Removal for Pavement Widening in Iowa 40
By C. L. Grieson, Construction Engineer, Iowa State Highway Commission

Proper Sizing of Excavators vs. Hauling Equipment 43

Unusual Overpass Completed for City of New Orleans 47

Triaxial Testing: Its Adaptation and Application to Highway Materials 49
By Chester McDowell, Senior Soils Engineer, Texas Highway Department

Knockin' Out the Yardage 53

Fifteen Years of Development in Soil Cement 54

The Local Roads Situation 56

The New York People's "Voice from the Crossroads" 59
By Charles H. Sells, Executive Director, New York Good Roads Association, Inc.

1949 Equipment Review ..... 64 and 104

New Equipment and Materials ..... 66 and 105

Bituminous Roads and Streets

Seven Management Factors Helped This Contractor Avoid a Winter Carry-Over 79

U. S. 90 East Texas—Case Study in Roadway Modernization 82
By R. E. Killmer, District Engineer, Texas Highway Department

Asphalt Paving Technologists Hold Lively Meeting at St. Louis 92

Practical Questions and Answers on Tar Treated Gravel Roads 94
By George E. Martin, Consulting Engineer, Paving Materials Section, The Barrett Division, Allied Chemical & Dye Corp., New York, N.Y.

Cost Estimating for Bituminous Concrete 99
By E. T. Nettleton, Associate Highway Engineer, Connecticut State Highway Department

Manufacturers' Literature 112

Clearing House 116

A magazine devoted to the design, construction, maintenance and operation of highways, streets, bridges, bridge foundations and grade separations, and to the construction and maintenance of airports.

Gillette Publishing Company, Publication and Editorial Offices, 22 West Maple Street, Chicago 10, Ill.

Chicago Office..... H. J. Conway, Advertising Manager, 22 W. Maple St.
R. T. Wilson — E. Bender
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Acceptance under Act of June 5, 1934. Authorized April 16, 1948, at Mount Morris, Illinois. Published monthly. Subscription price $5.00 per year.

B.F.Goodrich

ALL-NYLON tire record:

no blowouts, no bruise breaks, no flex breaks!

THE B.F.Goodrich ALL-NYLON tire is proving successful on construction projects all over the country. The record speaks for itself — up to now no blowouts, no bruise breaks, no flex breaks! And that includes severe operating conditions on jobs where flex and bruise failures formerly were common.

Along with nylon, BFG uses weftless construction; no cross-threads in tire plies to hamper cord action and allow some cords to stretch out. Therefore, tire growth is reduced—tires last longer.

Nylon tires always provide big savings on construction projects, in quarry and other operations where heavy loads and rough terrain have made tire costs high.

The new, all-nylon construction is typical of the continuous improvements being made in tires by B.F.Goodrich. Long ago, BFG engineers developed special types of tires for construction and other off-the-road service. For more information on the way B.F. Goodrich tires can do more work and save you money, call your BFG dealer —or write directly to *The B.F.Goodrich Company, Akron, Ohio.*

LIFE LINE FOR TAR MIXERS

Penflex flexible metal hose assures trouble-free transmission of hot tar for road surfacers

ON PAVING MIXERS, Penflex hose is ideal for free-flowing transmission of tar from tank trucks to mixer. Resists crushing, kinking, severe abrasion.

ON ROAD SPRAYING TRUCKS, precision-made Penflex offers tight, leak-proof service for filling tanks and for connection to spraying apparatus.

ON TAR AND ASPHALT HEATERS, Penflex hand hose, shown on left, prevents dangerous burns to operators using hand sprayers. Sturdy interlocked hose is insulated with heavy braided asbestos. Entire unit is encased by larger diameter hose with heat-proof couplings attached, assuring constant protection and safety.

48-HOUR DELIVERIES ARE OFFERED on the above items to meet emergency requirements. Call on Penflex for a complete line of flexible metal hose and couplings for efficient, long-lasting service plus helpful engineering assistance for the solution to your flexible tubing problems. Write today for Bulletin No. 91.

PENNSYLVANIA FLEXIBLE METALLIC TUBING CO.

7216 Powers Lane — Philadelphia 42, Pa.

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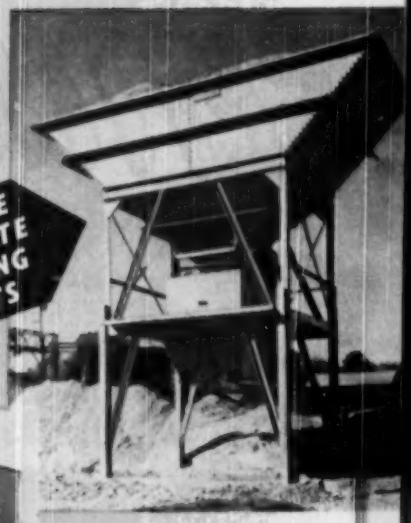
BLAW-KNOX

BATCHING PLANTS REALLY CUT CONCRETING COSTS

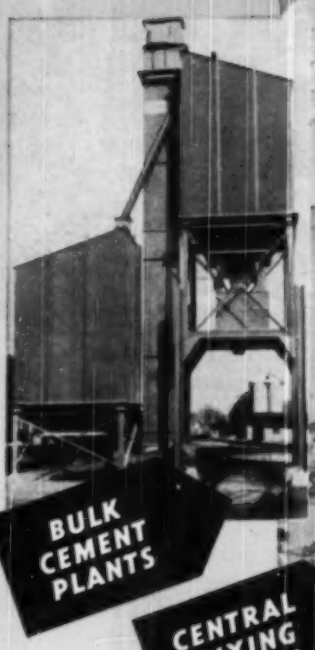


PORTABLE AGGREGATE BATCHING PLANTS

HERE'S a complete line of portable batching and mixing plants that will keep your fleet of trucks moving all the time. Big capacity for aggregates and cement means there's never any waiting for the crane to catch up or for spotting cement cars for unloading. Twin batchers, and choice of manual or automatic controls for Water Weighing Tanks, electrically operated discharge gates on bulk cement plants are only a few of the features that assure fast, accurate batching.

Capacities of aggregate plants range from 100 to 120 tons in two, three or four-compartment styles, bulk cement plants of 300 and 400 barrel sizes with combination arrangements to double these capacities.

The flexibility and portability of Blaw-Knox batching and mixing plants provide the solution to ready mixed concrete operations, central mixing plants or concrete products manufacturing problems. See your nearest Blaw-Knox distributor for details.



BULK CEMENT PLANTS

CENTRAL MIXING PLANTS

Hi-Boy Trektmixers

Clamshell Buckets

Concrete Buckets

Steel Street Forms

TRUCK MIXER LOADING PLANTS

BLAW-KNOX

BLAW-KNOX DIVISION of Blaw-Knox Company
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Birmingham • Chicago • New York • Philadelphia • Washington

55 Allis-Chalmers Tractors and Motor Graders

SETTING SERVICE

42 HD-19 Hydraulic Torque Converter Tractors

Leveling Fill

Pushing Loader

12 Model AD Motor Graders

Maintaining Haul Road

Boosting Haul Wagon

Sloping Bank

Pulling Tamping Rollers

"SEEING IS BELIEVING"

Ask your Allis-Chalmers Dealer for a demonstration

RECORD

for PETER KIEWIT SONS' CO.
and
MORRISON-KNUDSEN CO.

on their 18½-million-yard Garrison Dam job in North Dakota, World's Largest Rolled-Earth Fill Dam.

Fleets of A-C's have set a terrific pace since early in 1949 on this 20-hour-a-day, six-day-a-week job. Production during good weather hit 100,000 yards and more a day! YET DOWNTIME HAS BEEN MUCH LESS THAN THE CONTRACTORS ANTICIPATED—based on previous earth-moving experience.

This outstanding service record again demonstrates that A-C equipment is built to take it. Proves again that extra production time is gained through such advantages as simplified adjustments and repairs . . . electric starting . . . quick, easy removal of major assemblies . . . interchangeability of many GM engine parts on all makes and models of A-C diesel tractors and motor graders. PLUS extended lubricating periods — 1,000 hours on truck wheels, idlers and support rollers.

For more production, for less upkeep, think of Allis-Chalmers when you think of road-building equipment.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

Originator of the Torque Converter Tractor

Big Bruisers

LOOK UNDER THE HIDE

When buying, look under the hide to see what you're getting. Foresight is cheaper than hindsight.

INDIVIDUAL FUEL INJECTION PUMPS for each cylinder – meter the fuel, time the injection, and provide accurate injection pressure. Pumps operate at half engine speed – an important factor in their long life.

NON-CLOGGING, SINGLE-ORIFICE FUEL INJECTION VALVES give clean, efficient combustion throughout the entire operating range of the engine – low idle, part load or full load. They are non-adjustable and interchangeable.

METAL-EDGE TYPE OIL FILTERS consist of four nested parts which provide a large filtering area. The full oil flow passes through these filters continuously, allowing no chance for harmful particles to be circulated by the oil stream.

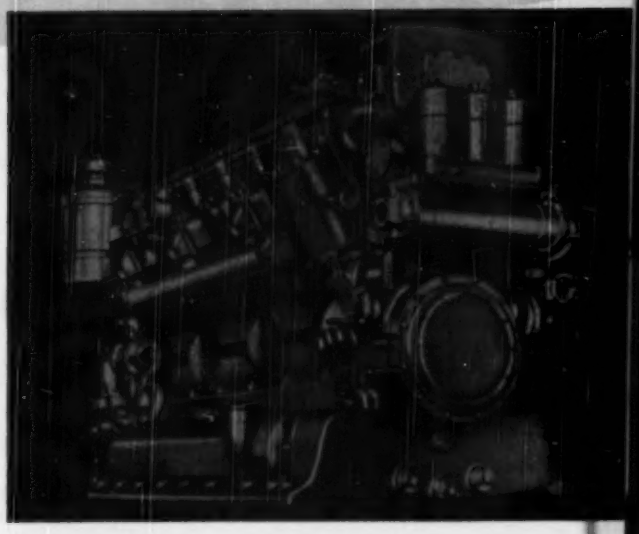
ABSORBENT TYPE FUEL FILTERS consist of a filter paper covered core wound with cotton yarn in a closely controlled pattern so that the entire depth catches and holds even the finest abrasive particles. The low-cost filter elements safeguard the fuel injection parts.

CONVENIENT FUEL PRIMING PUMPS and air bleed valves enable the fuel system to be bled with very little effort. A glass window makes it easy to tell when all air has been removed.

AIR STARTING consists of a vane type air motor which cranks the Diesel through a Bendix type drive engaging the flywheel ring gear. The motor, air pressure regulator, oiler, and control valve may be mounted on either side of the engine.

ELECTRIC STARTING consists of two 32-volt motors mounted on each side of the engine. As in the case of air starting, the Diesel is cranked through a Bendix type drive.

NEED Big Muscles



LOADING, lifting and swinging a full 7-yard load from the end of a 120-foot boom is no "pantie-waist" exhibition. For handling such big bites, the Ruby Construction Company, Inc., repowered their giant Bucyrus-Monighan dragline with the big new 400-horsepower "Caterpillar" D386 Engine. Because of the power and lugging ability of the "Cat" Diesel, bucket size was increased from the original 5-yard capacity. With its more "muscular" "Cat" Diesel, the outfit has moved more earth at a faster rate than it has ever done before.

The D386 and the still more powerful D397 (500 hp.) have extended the line of "Caterpillar" Diesels to meet a much wider range of power requirements. Built in "Caterpillar's" huge new engine factory, "Caterpillar" Diesels offer you many exclusive, profit-making features. By specifying "Cat" Diesels on your equipment orders, you are assured maximum economy, utmost dependability, and lowest maintenance costs.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

SPECIFY "CATERPILLAR" DIESEL POWER IN THE NEW EQUIPMENT YOU BUY—AND FOR REPLACEMENT IN THE EQUIPMENT YOU ALREADY HAVE.

CONSIDER the quick and efficient parts-and-repair service that is available to you (no matter where your headquarters or jobs are located).

USE THE COUPON for specifications and other information on "Cat" Diesels. No obligation.

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ENGINES • TRACTORS
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EARTHMOVING EQUIPMENT

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Send specification sheets on "Caterpillar" Diesel Engine models and sizes.

Name _____

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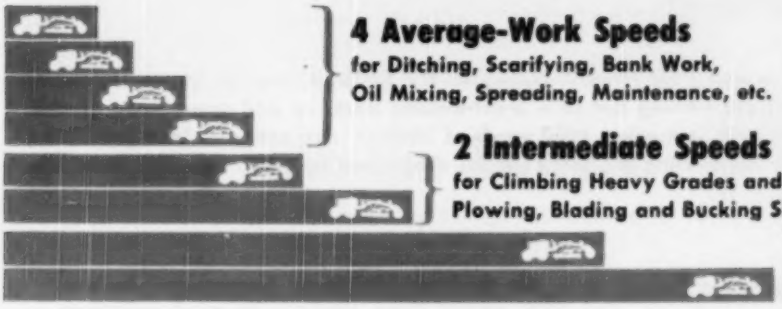
Only Adams

Gives you this exclusive combination of advantages

1. **8 OVERLAPPING FORWARD SPEEDS**
2. Wide Range of Blade Positions Without Mechanical Adjustments . . . Save time in adapting machine to needed cuts.
3. Positive-Action Mechanical Controls . . . Dependable, accurate adjustments—because they're geared . . . easy, natural steering.
4. Ample Operating Clearances . . . Quick, easy adaptation to work . . . Operator comfort, convenience, efficiency.
5. Fast, Easy Servicing Plus World-Wide Dealer Service . . . Saves time and money.

1 8 OVERLAPPING FORWARD SPEEDS

for Faster Work—for Faster Transport



4 Average-Work Speeds
for Ditching, Scarifying, Bank Work, Oil Mixing, Spreading, Maintenance, etc.

2 Intermediate Speeds
for Climbing Heavy Grades and for Plowing, Blading and Bucking Snow

2 Transport Speeds

In Adams Motor Graders you get 2 more forward speeds than in several machines of comparable size and power—8 forward speeds instead of 6.

These additional 2 speeds give you an extra working speed and a higher "high"—as much as 25 mph. You get greater selectivity of speeds on all types of work—an exactly *right* speed for accomplishing each motor grader operation at the fastest practical rate . . . plus 30 to 50% faster job-to-job transport.

Let your local Adams dealer show you how 8 forward speeds—in combination with other Adams advantages listed on opposite page—speed grader operations, increase efficiency, reduce costs . . . *right from the word go!*

J. D. ADAMS MANUFACTURING COMPANY • INDIANAPOLIS, INDIANA

Make your next motor grader an

ADAMS

4 LaPLANT-CHOATE MOTOR SCRAPERS MOVE 5000 YARDS A DAY *UP AND DOWN STEEP GRADES*

• 4 Motor Scrapers working for Frank J. Hickey on the 610,000 yard job at the University of California at L.A., are moving dirt at a profit-making pace, up and down steep grades. Each of the four LPC units is moving 1250 yards of 2600-lb. clay every 10 hour shift, on a 2800-ft. cycle, easily negotiating the steep grades occasioned by 30-ft. cuts and 60-ft. fills.

Profit-Producing Features

- **225 H.P. Buda Diesel**
- **45 H.P. Continental Starting Engine**
- **12 Cu. Ft. Westinghouse Compressor**
- **32 Amp. Autolite Generator**
- **Lipe Rollway Clutch — 17"**
- **Fuller Transmission – 4 A 112**
- **4-Wheel Timken-Detroit Air Brakes**
- **Double-Acting Hydraulic Steering**
- **Big 24:00 x 29 Traction Type Tires**
- **Big Capacity — 14 yds. struck — 17.5 yds. heaped**
- **Big speeds — up to 21.2 mph**
- **Positive Forced Ejection plus High Apron Lift**

On the level, LPC Motor Scrapers can't be beat! And up and down grades or in tough conditions, they're more unbeatable than ever for moving the *extra* yardage that gets the job done faster at lower cost per yard. Frank Hickey and other big time contractors lay the blue chips on Motor Scraper performance every time. For day-in, day-out dependability and production, LPC Motor Scrapers are first choice on more and more jobs each day. Get all the facts from your LPC distributor, La-Plant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa — West Coast Branch, 1022 77th Ave., Oakland, California.

FAMOUS LaPLANT-CHOATE DOZERS — both angling and straight blade — are again available in either hydraulic or cable-operated types. See your LPC distributor NOW!

LaPLANT CHOATE

WIDE ROAD!

Fredrickson & Watson Laying 13-ft. Road at Plumas, Calif.

(above) Laying 11-ft. road in Indiana.

(below) Road widening and feathering into the road crown.

—Easy with the ADNUN

THE unusual flexibility of adjustment and the versatility of the Adnun makes it possible for you to handle a range of black top specifications any other Black Top Paver would find difficult.

Wide road beyond the width of the standard hopper is easy with the Cutter Bar Extension and Edger Plates. Hydraulic Controls and End Gates permit feeding material out beyond hopper. Roads up to 13 ft. have been laid successfully.

Cutter Bar adjustments permit laying any Crown or Bank and on shoulder widening the new shoulder can be feathered into the old crown. With hopper sections narrow strips can be laid between car lines or parallel to existing road for any degree of shoulder widening. Full control of the tilt of the Cutter Bar along with a Screed Heater assures the efficient handling of any type of mix. No other Black Top Paver gives you such range of control.

If you are figuring on a black top job you should have full details.

THE FOOTE COMPANY, INC.

Subsidiary of Blaw-Knox Co.

1936 State Street • Nunda, New York

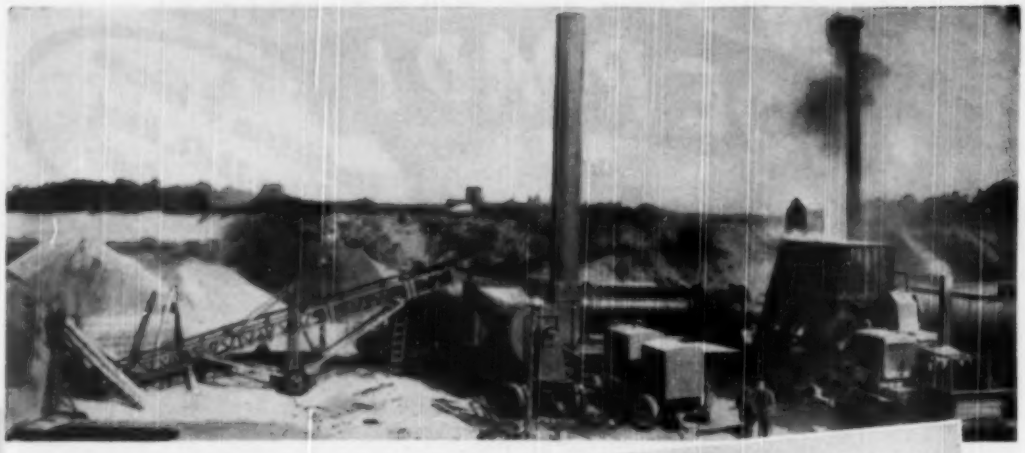
If you pour concrete the Foote HighLift Boom will cut your pouring costs.

The Kinetic Asphalt Mixer saves money on patching and repair jobs.

ADNUN

TRADE MARK REGISTERED

BLACK TOP PAVER



THESE BIG ASPHALT PLANTS ARE

Going Places!

● How would you like a big asphalt plant that you can set up in a few hours . . . one in which all mixing operations are fully automatic?

Now, you can get these two important features . . . plus many more . . . in a plant that produces 100-150 tons of material an hour. It's PIONEER'S Continuous Process Asphalt Plant.

This big plant consists of only three main units, the mixer and the dryer and the dust collector. Each is a complete unit mounted on its own pneumatic tired truck. *It's the most portable large asphalt plant ever built.*

All mixing operations are fully automatic . . . fully controlled, because the asphalt metering pump and the aggregate feeder are interlocked. They are synchronized to work together. The human element in proportioning is out . . . the correct mix is assured.

If you're going after big black top jobs this year, better get full details about PIONEER'S Continuous Process Plant now. It can give you better material mixed to closer tolerances at lower cost per ton. Mail the coupon today for our new handbook.

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BUY BOTH!
Higher Output, Lower Upkeep!

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Continuflo EQUIPMENT

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● Please send me your new handbook on Pioneer Continuflo Asphalt Plants.

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Address_____

City_____ State_____

This 145-horsepower Series F-7 Ford Truck has a Gross Vehicle Weight rating of 19,000 lbs.

"We've cut sand hauling costs 30% with our Series F-7 Ford Truck" —SAYS F. M. LeGATE, Jr.

JACKSONVILLE SAND CO.
JACKSONVILLE, FLA.

"We were faced with mounting hauling costs because of increasing length of haul and greater traffic congestion," reports F. M. LeGate, Jr. of the Jacksonville Sand Company. "Then we changed to a series F-7 Ford Truck.

"This new 145-horsepower Ford has done the job. Hauling six yards of sand instead of the four yards hauled by our older model trucks, it has cut our cost per yard by 30%."

In any line of business, *Ford Trucks do more per dollar!* They go easy on expense for gas, oil and repairs. They're strong on work output. Ford Trucks are built with big reserves of strength and power to handle big loads at low cost.

Let your Ford Dealer show you which one of over 175 models is the one right truck for your job.

HERE'S WHY AMERICA'S NO. 1 TRUCK VALUE WILL DO MORE PER DOLLAR FOR YOU!

- **SAVE GAS** with Ford Loadomatic ignition and High Turbulence combustion chambers.
- **SAVE OIL** with Ford Flightlight aluminum alloy pistons.
- **SAVE WEAR** with pressure lubricated main and crankpin bearings, Double Channel frame, extra heavy duty axles, big brakes (up to 16-in. x 5-in.).
- **SAVE ON REPAIRS** with demountable brake drums, brake inspection hole, engine-top setting of accessories, plus nationwide service from over 6,400 Ford Dealers.
- **SAVE TIME** with Ford reliability and performance. Up to 145 horsepower. Only Ford gives you a choice of V-8 or Six!

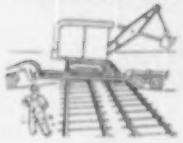
Ford Trucks Cost Less Because –

FORD TRUCKS LAST LONGER

Using latest registration data on 6,106,000 trucks, life insurance experts prove Ford Trucks last longer!

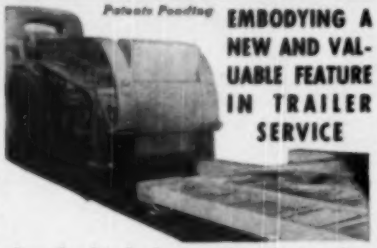
The ROGERS 4-FEATURE POWER-LIFT DEMOUNTABLE GOOSENECK

← STOOPS TO CLEAR LOW OVERHEAD OBSTRUCTIONS



← RAISES ITS DECK TO CLEAR HIGH BANKED CROSSINGS

Patents Pending



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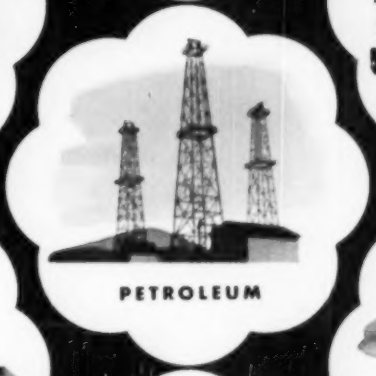
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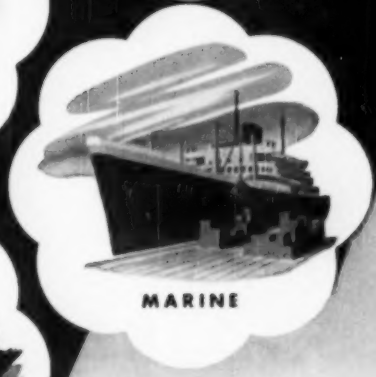
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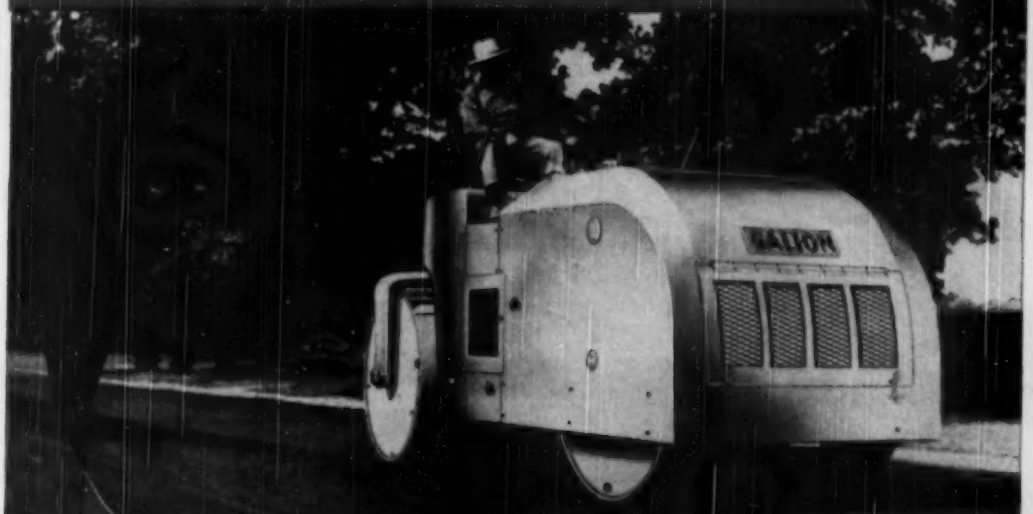

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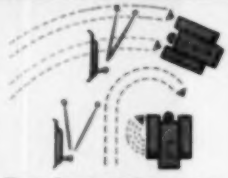

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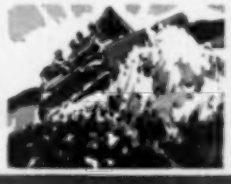

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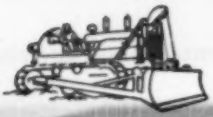

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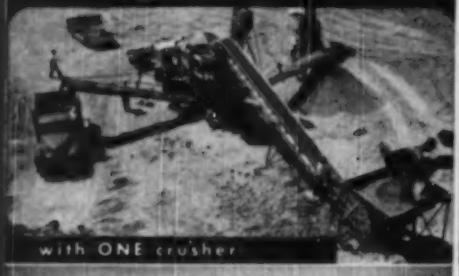
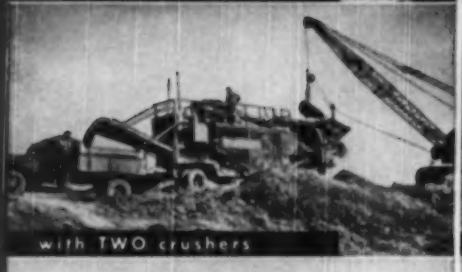


with ONE crusher



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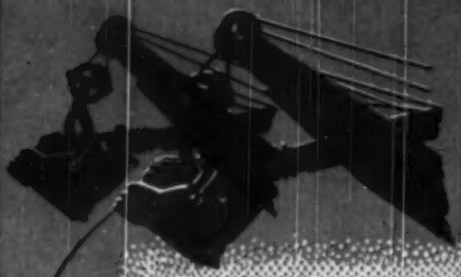

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Notice the difference soil-cement makes on the New Jersey street in the photo. The portion of the street in the foreground is suffering from spring break-up. The rest of the street, paved with soil-cement, is unaffected.

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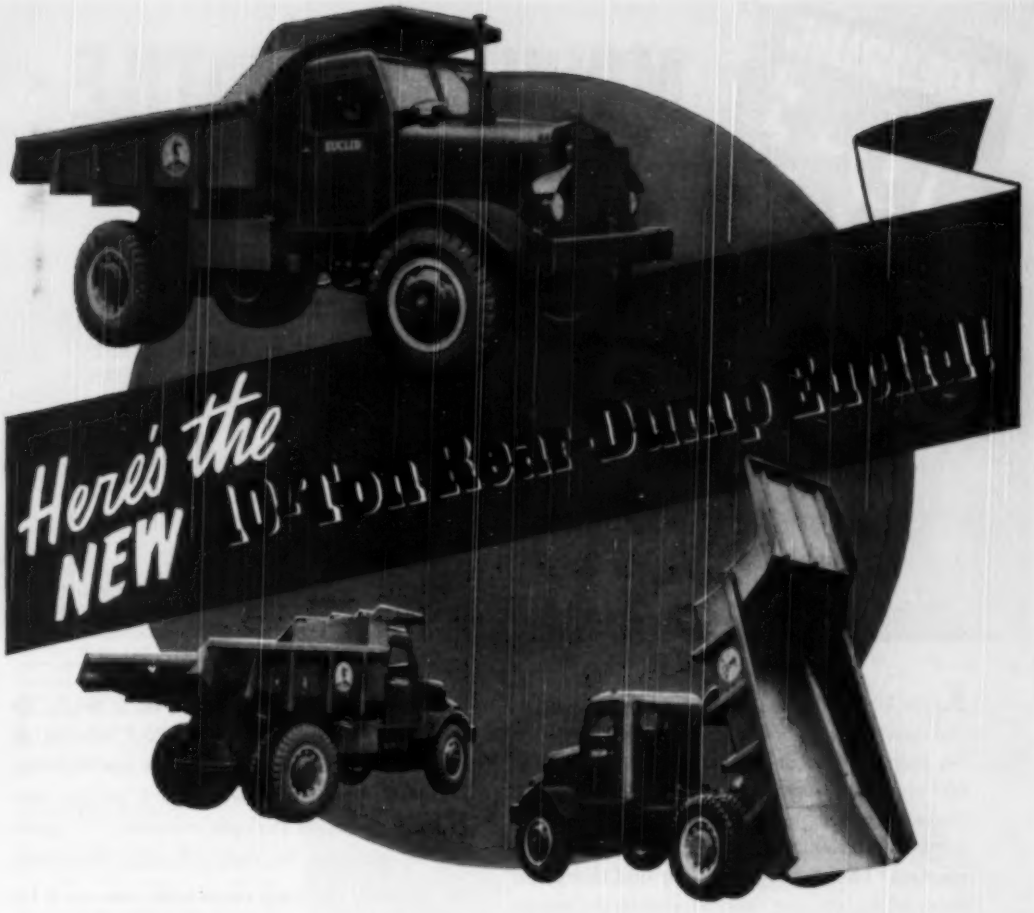

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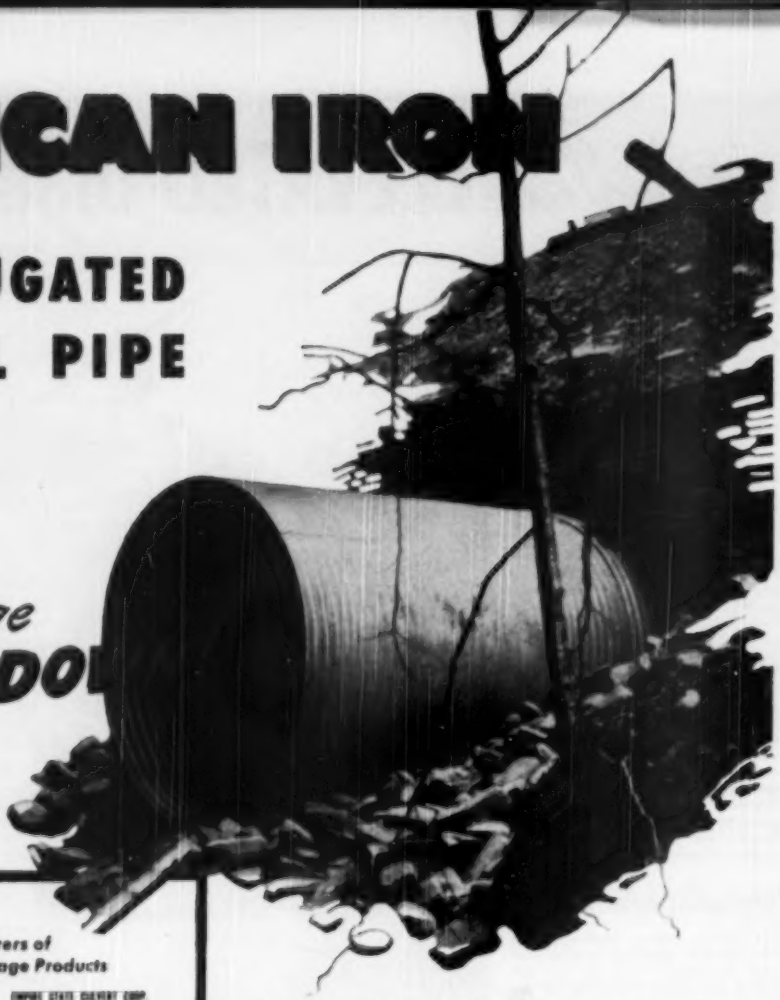

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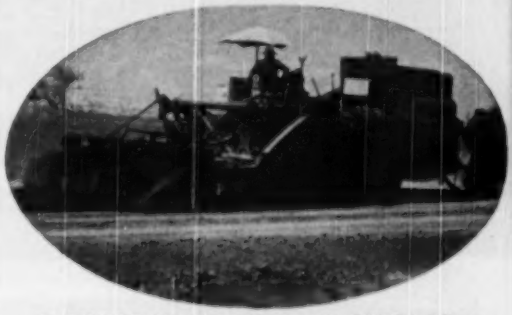
The sandy type soil in place ready for processing by the P&H Soil Stabilizer.



The P&H Soil Stabilizer processing at a rate of 500 lineal feet, 24-foot highway per hour.

U.S. HIGHWAY 281

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This P&H Soil Stabilizer, processed at a rate of over 500 lineal feet of 8-inch, 24-foot roadway per hour. Sandy soil required 4% to 5% MC-3 cut-back asphalt to provide maximum stability and minimum absorption. The roadway was then armor-coated with a single bituminous surface treatment.

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ROADS AND STREETS

March, 1950 • Vol. 93 • No. 3

"Blowing the Muck"

Example of Maine Swamp Filling Practice

Dynamite sticks are placed under "surcharge" fill material through iron pipes. Subsequent to the writing of this article, which appeared in a recent issue of "The Trail," the largest blast for this project was set off—nearly 4 tons of 40% gelatin. This blast aided in settling a 400-ft. length of road fill containing 12,000 cu. yd. of gravel.

By A. R. Curtis

Editor, "The Trail,"
Maine Good Roads Association, Unity, Maine

THE old corduroy roads our grandfathers built are gradually disappearing — in more ways than one. Built to float, pontoon bridge-like, over the many deep bogs and marshes to be found in Maine, they were the pioneer roadbuilders' answer to the problem of building roads across unstable muck areas. While such roads did an admirable job in earlier days, they were not, even then, famous for their permanence. Many are the stories of roads disappearing in the night—of rebuilding and then building again.

Such is the history of the short section of Route 202 which crosses the Green's Corner Bog in Maine. It represents only 1,000 ft. of the total of 1.27 miles of highway recently under contract by Farrin Bros. and Smith, Brighton, Maine, contracting firm. But it will require 60,000 cu. yd. of gravel to produce a road which will never sink again, while the remainder of the project will need 8,000 cu. yd.

15,000 Truck Loads

First step in the operation, begun late in 1949, called for removing an estimated 1,000 cu. yd. of muck from the shallow bog areas. A clamshell crane was employed. Before the work on this 1,000-ft. section of highway is completed, an estimated 15,000 truckloads of gravel will have been used, or about 15 loads per running foot of highway. At times the fill has been built up to a height of 15 to 20 ft. above the bog level, only to disappear during the night. This "surcharge" consists of a mound of gravel about as wide as the new roadway and about 20 ft. high along the centerline. If the muck underneath is soft enough, the weight of gravel fill will displace the muck to the sides, and the fill will settle in its place. This has occurred on other Maine bogs to some extent. Often, however, either the old roadbed helps support the heavy fill or the muck is too solid to be easily displaced. In this case the practice is to blow out the muck under the fill with dynamite to speed up the settlement.

The depth of the muck in the Green's Corner Bog varies from 8 to 35 ft. About 10 tons—40,000 sticks—of dynamite was estimated to be required to accelerate settlement.

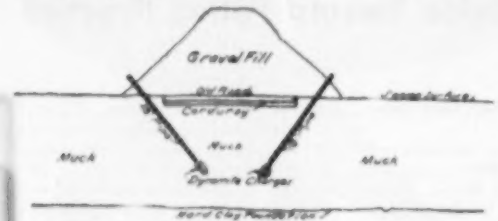
Settling fill by "blowing the muck" is not new. It has been done countless times in Maine. The method of "put ting down" the 1⅛-in. diam. pipes through which the dynamite is placed under the fill is, however, fairly new in this state. In the past, pipes have been driven into the muck and down

★ Jetting down diagonally under the new fill with a 1½-in-diameter steel pipe, which was then filled with dynamite cartridges and pipe withdrawn

★ Another view of the jetting, for which a 500-gpm. pump was used

★ "Before and after" the blasting of a section of "surcharge" fill placed across the swamp. Note at right how the fill, formerly 15 to 20 ft. above water, has become partly submerged

★ Men on the job: Lee Smith, Lyman Farrin and Tom Farrin, of Farrin Bros. & Smith, contractors; R. S. MacDonald, inspector; Frank Landers, resident engineer



to solid bottom with a hand maul, a long and tedious job. Often these pipes were left in to "go up" with the blast. On the Plymouth Causeway job in Maine, built in 1947, the pipe was forced down with the bucket of a power shovel. On that job a wooden point was whittled out and inserted at the bottom end of the pipe. Often the dynamite was "loaded" into the pipe and the pipe was removed by the shovel bucket, leaving the charge under the fill. This method works well where the muck is not too deep, but would be ungainly and difficult in deep bog areas.

The method of driving the pipe, as used at Green's Corner, is simple and fast. Only a source of water (which should be easy in a bog) and a high pressure pump are required. Five-foot sections of 1 ¼-in. pipe are used, through which water, under high pressure, is pumped. The jet of water displaces the muck and only one man is required to push the pipe down. As each section is driven, another is screwed on and the operation goes on until the pipe has reached solid foundation.

Farrin Bros. and Smith are using a 500-gpm. trailer fire pump to provide a large quantity of water under high pressure for this operation. An interesting detail is that the jet method continuously shows the character of the material at the lower end of the pipe, by the color of the water bubbling up around the pipe. The bottom of the Green's Corner Bog is clay, which can be easily seen by the color of the water when the pipe is driven to solid material. When the pipe strikes an obstruction, which under other methods of driving pipe might appear to be solid bottom, the pipe is removed and started over again unless the water is showing the characteristic clay color.

The pipes have been driven 8 to 12 ft. apart, depending upon the depth of muck, and loaded with dynamite on the basis of one stick (½ lb.) for each cu. yd. of muck to be displaced. The dynamite is rammed to the bottom of the pipe with a stick. Primacord is attached near the top of the charge. The pipe is then removed, section by section, the ramming rod holding the dynamite in place under the fill until all pipe is removed.

The "blows" made up to this writing, in the shallow south end of the bog, required only 250 lb. (500 sticks) of dynamite. The second "blow," where the muck was 10 to 15 ft. deep, required 1,500 sticks for a section of fill about 100 ft. long. A later blast required 3,400 sticks, or about 3 cases (150 sticks) to a hole. This is the maximum which will be used to a hole and then only where the muck is the deepest.

Several more blasts are planned to settle the entire fill, of which only about 40,000 cu. yd. was placed by late 1949. The fill settlement has been very satisfactory so far, with all evidence indicating that the gravel in settled areas in on solid bottom. This project is planned for completion in 1950 with a tar road-mix surface.

Job superintendent is Tom Farrin and the inspector for the state is R. S. "Stan" MacDonald. Frank Landers is resident engineer.

American Cyanamide Co., which supplied the dynamite, provided technical assistance.

★ The jetting pump is glimpsed at extreme left. Note settlement cracks in new fill material

●

A floating bridge or floating tunnel 13,600 ft. long is being considered for a 4-lane trafficway across an arm of Puget sound in Washington state.

EDITORIAL

★ Light on the Heavy Axle Load Problem

One of the best pieces of news in highway engineering recently is the announcement of a truck load test project, using actual trucks and a section of existing highway. The Maryland roads commission, U.S. Bureau of Public Roads and Highway Research Board are cooperating. The argument over the effects of heavy axle loads on pavements cannot progress much further without engineering facts. A single test report is worth ten million words, to paraphrase Confucius. Meanwhile the road wreckage from excessive loads continues.

★ Specifications Affect Bid Prices

Millions of dollars' worth of highway, airport and other construction work continues to be built under specifications which defeat the purpose for which they were worded. Written to gain the most for the taxpayer or letting agency, they actually result in higher construction costs, because contractors comb them through and then raise their bids.

We are referring again to the subject of general construction specifications, with special reference to proper distribution of risks between owner and contractor. This subject has been thrashed out over and over again in organization meetings since the war, and some states have made progress in clarifying specifications. But there is still a long way to go.

It still seems to be the tendency for engineers to avoid the responsibility for unknown hazards as much as possible. This practice may save the owner a few thousand dollars in the form of extras, but it costs the collective owners millions of dollars through increased bid prices because of such contingencies.

One illustration, given us by a well-known contractor in discussing this subject, is that of a government agency taking bids on an earthfill dam costing several millions of dollars and specifying that the contractor shall be responsible for any damage to the work in place until the project is fully completed and accepted. By way of contrast, another government agency called for bids on a similar structure and specified that if the contractor followed the instructions of the contracting officer, the government would pay for the replacement or repair of any of the permanent work which might be damaged during construction. This is a very important item when building an earthfill across a valley which is subject to flood.

Contractors who are well informed can, of course, protect themselves against these contingencies, but on the whole, such practice costs the owner large sums of money for hazards which do not develop.

★ Our "Working" Roads Should Come First

The other day a group of people met in St. Louis to hear of progress made in reconnaisance surveys for the proposed Mississippi River Parkway. This project has been agitated for some time. Congress last summer voted a small sum for investigating the feasibility of the Parkway, which would be built from Minnesota to the Gulf in the name of recreational and wild life development.

A scenic parkway of this kind, if properly located, would serve local community needs along the route. And it might bring new money into many localities, in vacation and tourist trade.

But without exception the states which the Parkway would traverse are so hard pressed for road repair and reconstruction funds that the farm-to-market and town-to-city routes all over the states—the "working" highways—should have the priority on any easy money floating around.

No major projects should be planned in this country that do not provide for trucking as well as automobile traffic. Congress in planning new federal highway aid beyond 1951 should properly be asked to consider the over-all or system highway needs first.

AASHO Construction Manual Available

"Manual of Highway Construction Practices and Methods." The first edition of this important publication has just been issued by the American Association of State Highway Officials. Said to be unique in the highway construction field, it contains data representing the composite judgment of outstanding highway engineers throughout the country.

The manual describes what are considered to be acceptable practices and methods currently used in various types of highway construction work in the United States, dealing with the nature of the work to be performed, materials to be used, objectives and basic principles involved. Its purpose is to provide information that would be helpful to construction personnel, students, engineers from foreign lands and others who may not be entirely familiar with the practices and methods described. The manual covers soils, drainage, earthwork, base courses, and surface courses, untreated base courses and surface courses, soil-cement base courses, soil bitumen, bituminous base courses and portland cement concrete, all in considerable detail.

The manual is available at $2.50 per copy. Address American Association of State Highway Engineers, Hal H. Hale, executive secretary; 1220 National Building, Washington 4, D.C.

★ Fig. 2. The latest model machine, devised by the state highway maintenance department, includes a swiveling suspension arm for the chipping mechanism; all equipment on the pavement

★ Fig. 3. Careful attention to traffic safety has been a feature of the state's procedure

★ Close-up of the breaker in action

Sloping Curb Removal

for Pavement Widening in Iowa

Over 200,000 lineal feet of lip curb removed by means of special equipment designed by Iowa highway department engineers. Low unit costs obtained as a challenge to state's contractors

By C. L. Gleason
Construction Engineer, Iowa State Highway Commission, Ames

IN the early days of paving in Iowa one of the projects was located in the loess soil section in the western part of the state. This is a hilly section and the soil is very erodable. The steep grades and easily eroded soil required a special method of controlling the water so as to prevent edge ruts. The lip curb or sloping curb was developed to meet these conditions.

This curb proved to be satisfactory to meet these conditions and was adopted as a standard over the entire state, sometimes being used on relatively flat grades.

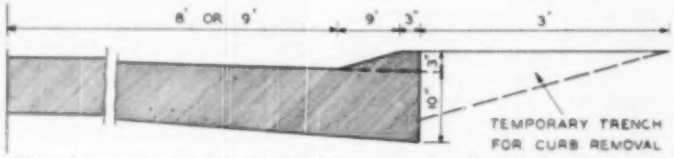
At the present we have 5,600 miles of two-lane concrete pavement, about three-fourths being 18 ft. wide, a small mileage 22 ft., with the remainder 20 ft. Sloping curb was used on a good deal of this pavement where the grades would carry the water. In some sections the curb amounts to 75% of the pavement's length. It was recognized that this curb would present quite a problem when it became necessary to resurface and widen these pavements.

In 1948 about 50 miles of pavement surfacing and widening jobs were let. This required the removal of 50,000 ft. of curb. No machinery had been developed to remove this curb economically. To fill in between the curbs would have cost several thousand dollars per mile.

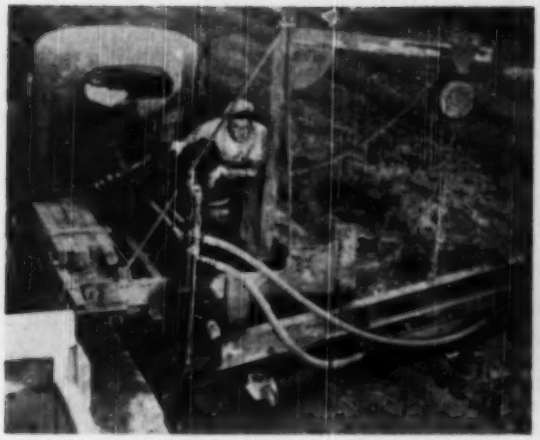
Inquiry was made in adjoining states where sloping curb had been used as to methods developed for removing curb. The information received was that small amounts had been removed and only hand methods had been used. No separate cost records had been kept. It appeared that hand operated pavement breakers would be too slow to handle the large amount of curb we had to remove.

Machine No. 1

While we were working on this problem we received a Junior Model pavement breaker from the Martin-Rosa Tractor Company of Davenport, local agents for the R.P.B. Corporation of Los Angeles. The machine consisted of a cylinder 6 in. in diameter and 48 in. long, containing a piston



★ Typical cross-section of old pavement showing lip curb to be removed and trench dug in process



★ Figs. 1 and 4. Left: Earlier model machine, used in 1948, made rapid progress but complicated the work by riding the shoulder trench. Right: A section of pavement with lip curb removed

with a 38-in. stroke. The outer end of this piston has a "hammer head" weighing 264 lb. This machine was manufactured to operate in a vertical position, and strikes a 10,000 ft. pound blow. It is able to break through a 10-in. slab in one blow.

It occurred to us that we could lay this piston down and operate it in a horizontal position and knock off the sloping curb. Our first machine shown in Fig. 1 was mounted on an old truck chassis and in spite of its makeshift construction worked very well.

It became necessary to develop a tool or cutter head that would work on this curb. This tool has an 8-in. face, cut to a slope of 5 degrees from the vertical to allow for the slope of the cylinder, and a 1-in. "splitter" along its bottom edge.

The first machine was used during the 1948 season and our costs were 5.58 cents per lin. ft. of curb removed. This included picking up the curb, removing it and filling the trench.

Machine No. 2

From the beginning we had planned on building a machine that would run entirely on the pavement and support the breaking equipment from a beam overhanging the pavement.

The machine shown in Fig. 2 consists of a 315 cfm. compressor mounted on a specially built chassis. A counterweight of 3,200 lb. is used to counterbalance the overhang of the cylinder assembly when it is in the working position. There are no springs under the rear axle to do away with the sway of the machine when it is operating. The chassis is self-propelled by an air motor running through two truck transmissions to increase the power of the small air motor. The brakes are a combination of air and hydraulic. The total weight of this machine is 15 tons.

We found from our experience with the old machine in 1948 that it was better and faster to have one operator control all of the operations of this machine. These operations consist of three things: First, spot the machine so that approximately one foot of undisturbed curb can be struck by the hammer or tool. Second, pull the valve that turns the air into the cylinder. This hammer then strikes a blow of about 10,000 ft.-lb., which is sufficient to break through a plane of concrete about one foot thick. The concrete is sheared off, breaking the rock as shown in Fig. 2. When this valve is released the cylinder returns to the ready position. Third, the operator steps on the air foot throttle, moves the machine ahead a foot, puts on the brake and strikes again.

In some cases it takes more than one blow, and also sometimes more than one lineal foot of curb is knocked off. The machine is practically foolproof and even a new operator becomes proficient in a few minutes.

This machine will remove up to 1,200 lin. ft. an hour, or 20 ft. per minute. The average is usually 1,000 ft. per hour or a mile in 5⅓ hours. This requires a good deal of concentration on the operator's part to be able to make all of these operations 15 to 20 times per minute. On account of this concentration, we change the operators once every 30 minutes. The spare operator then rests at the steering wheel. This is really a rest as all he has to do is keep the wheels in the trough of the curb, and he has nothing else to do.

Before removing any curb we visioned large pieces of curb being knocked off at one blow. We were disappointed as we found that the bond is almost perfect even though, due to the method of construction, there should have been a plane of

★ Fig. 6. A motor grader is used to trench out shoulder material, exposing the pavement edge prior to passage of lip removing machine

weakness. It is necessary to strike a blow almost every foot.

Steps in the Job

During the removal operations it is necessary to maintain one-way traffic. This is accomplished by means of two flagmen working about 200 ft. ahead and behind the breaker. These flagmen have a stop sign mounted on a wheelbarrow frame. At right angles to the stop sign is a white sign that can be seen by the other flagman when the stop sign is turned to "Proceed With Caution." This is shown in Fig. 3. Along the right is shown some of the curb that has been removed. This is also shown in Fig. 4 which gives a general idea of the smoothness of this operation.

Fig. 5 shows the arm folded for moving from one section to another. A tongue is inserted at the front and this machine is pulled by a truck.

The sequence of operations is first to open the trench with a large maintainer, Fig. 6. This trench must not exceed in width the width of the widening, which is usually 3 ft. on each side of an 18-ft. pavement to be widened to 24 ft. The inside of the trench is about 10 in. below the top of the curb, shown in Fig. 7. This is followed by the actual curb breaking. The curb is then picked up by hand, using two to three workmen in addition to the truck driver. This method was found to be cheaper and faster than using a front-end loader to pick up the broken concrete. It also requires two to three dump trucks, according to the length of haul to the stock pile. It is necessary to do a good job in cleaning up the broken curb, as a good sized piece covered up in the trench may cause trouble when the trenching machine opens up the trench later for pouring of the strip.

As soon as the curb is picked up the trench is filled again with the maintainer. The operator and the maintainer must be the best as the speed of the whole operation depends upon the opening of the trench. The trench is kept filled to within about 200 ft. of the breaker and this causes a minimum of inconvenience to the traffic. Usually the curb breaker will break off the curb faster than the maintainer will prepare the trench. After the trench is filled the small pieces are bladed from the pavement and normal traffic can be resumed.

A tolerance of 2 in. is set up in the specifications. In case of concrete resurfacing not over ½ in. is allowed above the pavement slab. When hot-mix bituminous surfacing is to be used the tolerance above the old pavement surface is 1 in. It is fairly easy to stay within this tolerance. However, it is necessary to check the curb after removal and any high spots are removed by hand operated air hammers. In some cases a second compressor is used. Another gadget that was developed is a single-wheel cart shown in Fig. 7, designed to take some of the labor out of dragging the pavement breaker.

The crew consists of one foreman, two curb breaker operators, one maintainer operator, two truck drivers, four hand laborers (picking up concrete) and one or two operators on hand operated air hammers.

The equipment consists of one curb breaker, two 1½-ton dump trucks, two hand-operated pavement breakers, and one heavy motor grader or maintainer. In 1948 we removed 49,597 lin. ft. of curb at a cost of 5.58c per foot. In 1949, 155,959 lin. ft. was removed in four counties. The low cost on 58,426 ft. was 4.7c per foot and the high cost was on 5,252 lin. ft. at 8.73c per foot. This latter project had several bridges on it and required a good deal of hand work as well as a long haul moving onto and off of the project.

Pavement in three of these counties was resurfaced with hot-laid sheet asphalt, and 1 in. was allowed above the slab as a tolerance. In one county, however, resurfacing was done with concrete and only ½ in. tolerance was allowed. In this case due to the extra hand work in trimming, the cost was 6.13 cents per foot on 39,245 lin. ft. on one project, and 6.74 cents on 40,356 lin. ft. on the other project. The entire cost, including rental on all equipment and labor for all operations, was $9,290.15 for 155,959 lineal feet removed or a cost per foot of 5.96 cents.

Bids from the contractors for removal of this curb ranged from 30 cents to 60 cents per lin. ft. of curb. The total bid by the successful bidders was $58,631.90 or an average price per foot of 37.6 cents.

Our cost does not include profit, nor does it include overhead, taxes, insurance, etc. The cost does include all cost to the state—labor, equipment rental, equipment depreciation, equipment operation, tools, supplies, etc.

Future Policy

The Iowa State Highway Commission does not desire to establish a permanent practice of removing sloping curb from concrete pavement by day labor. It is hoped that contractors may soon become interested in bidding on this work as an incidental item of the over-all widening and resurfacing projects. The state undertook the curb removal job on these first projects to demonstrate that there is nothing particularly difficult or expensive in removing this type.

It would seem, however, that the state will have to stay in this business for a few years until they are able to let the curb removal as a separate item and in amounts ranging from 500,000 to 1,000,000 lin. ft. per year, before contractors will be interested in investing about $13,000 in one of these machines. It is estimated that each of these machines could remove about 800,000 lin. ft. if it is operated entire season of about seven months.

The state is building a second machine to use during the 1950 season, since with the two machines we will be able to keep the curb removed in advance of several contracts even if let on or near the same date. The first new machine was so successful that few improvements are being made on the new machine being built.

★ Fig. 5. Front view of latest model machine, showing compressor mounting

★ Fig. 7. Minor hand work with pavement breaker only occationally necessary

Proper Sizing

of Excavators vs. Hauling Equipment

Part II. Sizing of Hauling Units and Fleet Synchronization

This discussion suggests how to select the proper sized excavating and hauling equipment for a well synchronized fleet fitting your needs. Presented by permission from copyrighted Technical Bulletin No. 3 of the Power Crane and Shovel Association. Part I, published in January, described Selection of Correct Excavator Capacity

II. Sizing the Hauling Unit

SINCE any deficiency in the hauling fleet must be directly reflected in output of the excavator, the sizing and quantity of haul units is of equal importance with the selection of the excavator itself.

However, because the excavator is a fixed equation with a production capacity which cannot be changed during its lifetime, and the haul fleet is made up of multiple units which can be increased or decreased in numbers at will to fit current conditions, much less attention is given to the selection of the haul fleet. Hauling may seem a less critical function and more easily remedied if things get too bad, but ignoring this sizing problem is not good business.

After having spent a lot of time and trouble selecting the right excavator, owners often fail to give it a chance to deliver its maximum of profitable production because haul units:

1. Are too small in size.
2. Are too few in number.
3. Have too much down-time.
4. Have insufficient standby units.
5. Have inadequate synchronization through traffic control, and
6. Are inaccurately spotted at the shovel.

Pay dirt capacity in the pit cannot pay dividends unless backed up by hauling capacity to deliver it on the dump.

If an average of 1 min. in every 15 is lost due to unnecessary truck delay . . . 4 min. an hour . . . 32 min. in an 8-hour day . . . about 7% of the cost for the shift is wasted. Or, from a production standpoint, income on half an hour production is thrown away. This may be anything from 15 to 200 yd., depending on excavator size and materials worked. Many jobs show an even higher preventable loss.

Because excavator size makes only a relatively small difference in fixed costs but makes a big difference in production, losses due to inadequacy in:

1. Haul unit size,
2. Mechanical efficiency, and
3. Fleet capacity

tend to pyramid in importance as the size of the excavator is increased. General prewar practice in sizing was to consider minimum haul unit capacity on a basis of 3 to 4 times the dipper capacity of the excavator.

Higher cycle speeds in modern excavators call for a *minimum* of 4 to 5 times the excavator bucket capacity. Table 10 illustrates why a larger minimum is recommended.

Standby Haul Units

Table 10 is a theoretical table of cycle time and will vary, depending on operator and operating conditions . . . hauling capacity always should be built up only on actual field performance data on specific jobs with specific operators.

A shortage in haul units tends to slow down an operator; an overage tends to push him for maximum production. The bigger the haul unit (within reason), the easier the synchronization.

For instance, according to the example shown in Table 10, with 3-yd. trucks, under a ¾ yd. excavator, an empty must be ready for spotting-in every 1½ min. That schedule is tough to maintain. A 4½-yd. truck, taking 6 dippers, would need to be spotted in every 2 min. That would be much easier to handle with minimum lost time.

To be sure, since the excavator loading is figured here with no delays, a 10-min. leeway may appear somewhere in the hour . . . or maybe it's 20 minutes in a 2-hr. period. But a haul unit should be under that dipper at all times! That means setting up equipment for a 60-min. hour rather than on an efficiency hour. In order to make a 50-min. hour shovel production average, the shovel must operate most of the time on a 60-min. basis.

Haul unit capacity, especially on low ratio units, should come out in even units of dipper capacity. Filling in each load with a half dipper is not profitable.

"Proper Sizing of Excavating and Hauling Equipment," Technical Bulletin No. 3, has been prepared by the members of the Power Crane and Shovel Association with the cooperation of hauling equipment manufacturers. Third of a series on the operation and maintenance of excavating equipment. Copies may be obtained by excavator owners, without charge, from local distributors or from manufacturer members of the Association. Or, they may be obtained for 50c per copy by writing to The Power Crane and Shovel Association, 74 Trinity Place, New York 6, New York.

Table 10—Haul Units Needed to Spot Under Shovel per Hour in Medium Digging

Size excavator dipper	Minimum haul unit capacity at 4 times dipper size	Approx. shovel cycle time in seconds 90° swing . . . no delays loading on grade	Loading time for 4-dipper truck in sec.	To synchronize loading spot one truck every	No. spots by hauling units at shovel needed per hr.
⅜	1½ yd.	19	76	1.26 min.	48 spots
½	2 yd.	19	76	1.26 min.	48 spots
¾	3 yd.	20	80	1.33 min.	45 spots
1	4 yd.	21	84	1.4 min.	43 spots
1¼	5 yd.	21	84	1.4 min.	43 spots
1½	6 yd.	23	92	1.53 min.	39 spots
2	8 yd.	26	100	1.66 min.	36 spots
2½	10 yd.	26	104	1.73 min.	35 spots

In sizing, note that dippers are rated by struck capacity which, in most materials, is about equivalent to bank measure or "pay dirt." In other words, the heap on the dipper usually takes care of the swell of the material when it is loosened in taking out of the bank.

Trucks are usually rated on water level capacity. Here again the swell is involved but the heap on the truck takes care of the heap on the dipper. In that way, rated dipper yards can be transposed into rated truck yards. *However*, all estimating should use actual job data rather than theoretical figures as listed in a textbook. Some materials do not follow the usual swell ratios, and job efficiency ratings vary in a wide pattern.

Following book figures to the letter in excavating can be disastrous. They list "par for the course" . . . every contractor must set his own handicap based on his equipment, his supervision, his operators, his local materials, his local weather.

1. Type of Haul Units. A wide and varied assortment of haul units is available today, each well adapted for certain types of haul. Following is a general list of the types of haul units which must be given consideration.

Standard Dump Trucks

A. Special rock and coal bodies are available in larger sizes.

B. Dual tires vs. singles.

C. Diesel vs. gasoline.

D. Two-wheel drive vs. 4-wheel or 6-wheel drive, 2 or 3 axle types.

E. Standard cab vs. cab over engine.

F. Special auxiliary equipment, etc.

Wagon-Type Equipment

A. Crawler or wheel tractor drawn.

B. Two-wheel or four-wheel prime mover.

C. Giant off-road or regular tires.

D. Rear, bottom or side dump.

E. Detachable or built-in haul unit.

F. Cable or hydraulic control.

Shuttle-Type Haulers

This type unit is especially to be considered on short haul work where turn time and fast spotting is a major factor.

Pick-up Body Type

These units have a crane device for setting down loading boxes to be picked up later. Principal application is for slow loading mechanized operations or where boxes are loaded by hand.

2. Standby Units. Mechanical efficiency of hauling units today is figured on (approx.) the same basis as excavators. Some estimators use 80% efficiency and some 50-min. hours for both types. However, it is obviously impossible to spread the 17% to 20% per-unit delay throughout a fleet of haul units uniformly so that multiple unit delays or long shutdown of a single unit will not interfere with the ability of the fleet to take away dirt or rock from the excavator as fast at it can be loaded.

The ability of the excavator to produce is conditional on the ability of haul units to take away material. Therefore, it is vitally important to provide not only ample haul capacity, based on a normal cycle time, but also for standby hauling equipment which can be put into operation quickly to replace the unit out with mechanical trouble. A flat tire or road delay, can throw fleet operation out of balance for a serious length of time . . . say a half hour or more.

Since fixed charges of ownership for a $10,000 hauling unit, for example, are only around $1.50 an hour or $12 a day, it will be readily appreciated that this extra expense for a standby unit is well justified, even on a small fleet and with average usage of the "spare" for only a small amount of time each day.

For instance, a haul fleet serving a 2½-yd. shovel loading good common earth on which job experience indicates a practical shovel output at 290 yd.-per-hr. Hauling is done with 10-yd. trucks . . . this means actually spotting in 29 trucks per hour.

Therefore, a truck must be ready to spot-in at the shovel every two minutes. If the length of haul indicates each truck to make 6 trips per hour, 5 trucks are needed to service the shovel. However, on a tight schedule like this, if one truck goes "down" for any reason whatever, 20% of the production is lost while it is out of service. If the down truck loses one hour . . . 20% of 290 yd., or 58 yd. of output is lost. If the selling price of the dirt is 50c a yd. the production loss is $29.

It will be seen that on many jobs two standby units will be justified where they will effect an average saving of one hour or more per day of short fleet operation.

However, figuring adequate standby units is not as simple as this. On most construction jobs, the length of haul varies continually throughout the job. Sufficient hauling units to handle the maximum length of haul must be provided. This will automatically supply standby units for medium and short haul ranges.

Hauling equipment can be prepared well enough to prevent time out for occasional brief intervals of operation on long haul. This will maintain peak haul production for a shift or two during intermittent periods.

When two or three excavators are operated on a job, a much more economical hauling fleet can be set up by working on the basis of average length of haul for the job. This means, balancing individual excavator haul fleets to match the average haul requirements. Work is planned so that when one unit is on long haul, another will be on short haul.

On a fleet servicing this type of multiple-excavator operation, it is usually good business to have one standby unit for each 5 units if the job is average; one in 8 units if over 25 units involved; one in 4 if only single excavator.

Where rented hauling equipment is available on short notice and at a reasonable price, the number of standby units can be reduced to a minimum. But, it is still important to have this minimum available right on the job ready to be put into service within a few minutes' time.

Adequate hauling units are also an asset in permitting servicing crews to handle their work during regular hours. Fueling, oil change, greasing and repairs can be scheduled without overtime rates by utilizing one of the standbys in the hauling fleet while the regular truck is in the shop. Care should be taken, however, that repairs which require tearing down of any hauling units, if possible, should be scheduled so as not to interfere with availability of adequate standby units to meet emergency requirements.

The excavator is the heart of the operation which pumps the blood of profit through the arteries of the haul units. That is the important picture of proper sizing, synchronizing and providing adequate standby reserves for the hauling fleet. Regardless of the ability of the pump to produce profits, cashing in on this ability is impossible unless the pipe line is adequate at all times to take away the

material and convert it into profits. Any delays are doubly expensive. They stop income but all overhead and direct costs of the job continue.

3. Haul Distance. In selecting hauling units, haul distance is an important factor in estimating haul cycle time and size of fleets required.

It is not proposed here to go into a technical discussion of factors involved, including:

1. Length of haul
2. Speed range of haul units under consideration
3. Relation power to load weight
4. Ability to get into high gear ratios
5. Grades encountered on both load and empty cycle
6. Rolling resistance of haul road
7. Turning time
8. Dumping time
9. Spot-in time at shovel

This summary is primarily concerned with the excavator phase of the operation. Since production is limited by the ability of the hauling equipment to take away the material with minimum delays, some suggestions are offered in the following. These pertain to the sizing and synchronization of haul units as related to their overall cycle.

4. Minimum & Maximum Fleets. In selecting hauling units, haul distance is a factor in two ways. Obviously, the size of hauling units should be such as to effectively utilize a minimum of two units and preferably three on existing length of haul.

For instance, if hauls are made from the ¾-yd. shovel with 6-yd. trucks, it would take 8 passes to fill. With a shovel cycle of 18 sec., it means a new truck must be put under every 2½ min. With the 3-truck fleet, each truck has 5 min., or, to provide a ½ min. safety lap at the shovel, 4½ min. for a safe travel cycle.

Obviously, if the truck size is tripled to 18 yd., 24 passes would be needed to load, taking about 7½ min. If it could haul and maneuver at the same speed as the 6-yd. truck, the shovel would be idle 4½ min. while the one big truck went to the dump and returned.

If two of these big 18-yd. trucks were used, loading time would take 7½ min., hauling cycle of 4½ min. and waiting time of 3 min. 8 truck cycles would be made per hour, with a 24-min. truck waiting delay. With the 6-yd. trucks, a ½ min. waiting time was provided at the shovel in order to allow for slight delays to the hauling units and difficulty of maintaining perfect synchronization of the cycle. With 24 cycles, 6-yd. cycles per hour, 12 min. standing time was accumulated. Deducting this from the 24 min. for the two 18-yd. trucks leaves only 12 extra minutes of excessive truck delay chargeable to the big units. This isn't serious as long as these two units are working and are moving full output away from our shovel. However, if one of the two trucks goes "down," 4½ min. production is lost out of every 12 . . . more than ⅓ of the pay yards!

To continue the analysis of checking a theoretical 9-yd. truck. Loading at a ¾-yd. shovel with 12 passes would take about 3¾ min. Assuming the same 4½ min. for haul, dump and return, there is a shovel delay of ¾ min. on every truck cycle because truck No. 1 could not get back from the dump before truck No. 2 is loaded out. With the two 9-yd. trucks and 13⅓ cycles per hour based on the 4½ min. haul, which is the limiting factor here, ¾ min. shovel waiting time is lost on each . . . 10 min. per hour . . . or about 17% of the earning capacity!

Therefore, on short hauls excessively large trucks involve serious problems of adjustment to eliminate waste time of either shovel or trucks, plus a serious fleet shortage in case of a delay to one unit in a too-small fleet. Big units also show loss on short haul work because of lack of maneuverability. This results in slow turning time and slow spotting at shovel and dump.

On the other hand, on long hauls, big units have certain important advantages beyond the savings shown by a comparative analysis of the bare per yard haul cost. Bigger units mean simplification of management problems . . . less men and less trucks to worry about and to synchronize . . . less units to maintain, repair, and less parts to stock.

5. Target Area of Haul Unit. In determining haul unit efficiency, a difficult factor to measure specifically is the advantage in shovel cycle speed obtained with a hauling unit providing larger target, making it easier to place on board a full capacity load without spillage waste. Losses of 10% to 20% in shovel production due to these factors can easily occur because of slowing down to spot the dipper and loss of yardage because of spill. This loss shrinks with a good operator, of course.

Suggestions For Spotting Trucks

1. Train crew for close-in spot for shortest possible swing cycle.

2. For back-in spotting, use log or tie for bumper to (a) get trucks in close, (b) provide uniform position and (c) permit fast truck spotting.

3. Wherever possible, use two-truck spotting so second truck is in and ready to load when first pulls out. Continues in line spotting is better if job layout permits on minimum swing cycle.

4. A spotter at excavator frequently will pay off in extra yardage. The operation should be studied and analyzed for extra yardage to be gained by efficient and uniform spotting. A test run should be made with top supervision handling and coordinating spot. If an appreciable increase in production is shown, needed supervision should be set up to maintain the gain.

For dragline loading, spotting on uniform radius is less important, but shortening swing cycle is definitely a production factor.

Approximate Shovel Digging-Loading Cycles for Various Swing Arcs

Time in Seconds—No Delays—Digging in Optimum Depths of Cut—Loading Trucks on Same Grade as Shovels

Size of Shovel Dipper	EASY DIGGING (Moist Loam or Light Sandy Clay)				MEDIUM DIGGING (Good Common Earth)				HARD DIGGING (Hard Tough Clay)			
	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°
¾ yd.	12	16	19	22	15	19	23	26	19	24	29	33
⅞ yd.	12	16	19	22	15	19	23	26	19	24	29	33
1 yd.	13	17	20	23	16	20	24	27	20	25	30	34
1 yd.	14	18	21	25	17	21	25	29	21	26	31	36
1¼ yd.	14	18	21	25	17	21	25	29	21	26	31	36
1½ yd.	15	19	23	27	18	23	27	31	22	28	33	39
1⅝ yd.	16	20	24	28	19	24	28	32	23	29	34	39
2 yd.	17	21	25	30	20	25	29	34	24	30	35	41
2½ yd.	18	22	27	32	21	26	31	36	25	31	37	43

Common Hauling Unit Difficulties and the Usual Remedy

1. Sluggish truck

Exchange truck for standby until maintenance crew can check and adjust. If no standby available, load ailing truck one dipper light.

2. Race-track driver

Correct driver and if correction fails, fire him. Over-speeding not only creates delays by throwing fleet out of balance but is also an unsafe practice and hard on equipment.

3. Slow dumping due to sticky material

Select sand or driest material in bank for spreading on bottom of load.

4. Slow dumping due to poor footing or difficult spotting

Trucks can be alternated on slow and fast dumping locations to maintain spacing, preferably with ratio of two fast to one slow. A short haul and fast dump can be planned for one truck to run around the machine being delayed for the slow dump.

5. Remedying any delay: at shovel end

Load first truck light and get it going if second waiting. Load outside of bank for short swing cycle. Overload last trucks to slow them down and equalize spacing. Get lead trucks to highball within safety limits.

6. Remedying any delay: at dump end

Dump boss to put first trucks in on shortest cycle and fastest dump, last ones in on longest cycle and slowest dump.

7. Trucks stuck in mud

Better haul-road maintenance called for. Good haul roads pay dividends in faster cycles and make it easier to maintain even spacing. Immediate solution, route first truck around, use second, if necessary, to pull stuck truck out.

8. No trucks at shovel

Operator loosens bank, cleans up corner, moves up even half a move, does everything possible to speed loading of bunched trucks which inevitably will follow.

9. General Suggestions

Drivers and operators should work as a team . . . use initiative to work out emergency problems . . . when spacing breaks down, work for speed-up of lead units and recovering of lost yardage rather than slow-down of tail units . . . incentive systems help, especially bonus for yardage over quota with participation by entire team.

This "target" penalty is highest on a small haul unit loaded with 3 or 4 dippers. As the haul unit size is increased relative to dipper capacity the target area naturally increases. Some haul units specially designed for shovel and dragline loading are shaped for maximum target area.

Target size is a very important factor in selecting hauling units for dragline service where doubling the haul unit from 5 x bucket to 10 x bucket will give even the best of operators a sizable percentage advantage in production.

6. Spotting at Shovel. Haphazard spotting at shovel is one of the most common and wasteful mal-practices in dirt moving.

Swing time is a major part of the shovel cycle. Cutting a 30° arc from the swing out and return (only 1/12 the full 360° circle) will increase shovel production by about 15% (see tables, page 30 and 31, PC&SA Bulletin No. 1). If the operator and drivers spot and load on a 180° swing when the job could be planned for 90°, nearly one-third of the possible production is lost.

In addition, accurate spotting of trucks at correct angle and in same relative position considerably improves operator's timing and speeds up shovel operation. Trucks always should spot on same radius to save racking dipper in and out. This should line up as closely as possible with radius of dipper as it leaves the bank.

III. Synchonization of Hauling Fleet

In sizing hauling equipment, consideration should always be given to the problems of synchronization of the fleet to permit the excavator to deliver its maximum output capacity. Accomplishing this is difficult with a rental fleet, particularly where rental is *not* on a per yard basis.

It involves many problems. Since the major one is the human factor, it presents an argument for largest units that show favorable unit cost factors in both excavators and haul units.

However, for efficient synchronization, it is very important to develop maximum cooperation of the drivers. They must work as a team, maintain spacing and position in line and thus provide a steady flow of hauling units properly spaced and spotted at the excavator. To achieve this co-ordination, drivers also must have the considered cooperation of both shovel operator and dump boss, as well as that of the maintenance foreman in scheduling service and repair operations.

One obvious loss sometimes encountered is in starting all haul units at the same time in the morning and after lunch, and quitting at the same time for lunch and at end of shift.

If work is begun with the whistle and 10 trucks start out at 7:00 at a shovel with 2½ min. loading cycle, nearly 2 truck-hours is lost in truck delay. Unless the boys lunch on the trucks nearly 4 truck hours more are lost at noon and another 2 truck hours at night . . . a total of 8 truck hours. A 5-truck fleet on the same shovel with 2½ minute loading loses 25 truck minutes at each start and stop or 1 hour and 40 min. for the shift.

If starting and quitting times cannot be staggered on the first-in first-out system used back in the old team-haul days, perhaps time losses can be reduced by arranging tire check, filling fuel tanks, and other chores in a sequence that will fill in this non-productive time.

In studying this lost time, it should be remembered, drivers avoid ganging up on a well supervised job and delays may not be readily apparent. Shovel operators also may cooperate by slow loading to respace the haul fleet. Slow down by trucks or excavators to recover spacing and avoid bunching does *not* solve the problem . . . yardage still is lost.

The plus of top efficiency yardage is *all* profit over the break-even point and well worth fighting for.

On large excavation projects, a special supervisor is often employed as truck despatcher or traffic control supervisor. On any job, careful supervision should be given to this important problem.

Any control system must be based on education and cooperation of the drivers and operators.

There are two phases of this control . . . the first deals with prevention of bunching . . . second phase covers correction after the first control has broken down.

Basically, the answer to the problem lies in maintaining an even spacing of haul units. When this commences to break down for any reason, immediate steps should be taken to readjust the spacing as promptly as possible, with minimum delay to the production of pay yards at the excavator.

●

Traffic fatalities for 1949 in the U. S. totaled 31,500, according to the National Safety Council. This represents a 3% drop from the previous year, despite 6% greater traffic volume.

Unusual Overpass

Completed for City of New Orleans

Alternate rigid-frame and cantilevered spans employed in 1212-ft. long overpass. Footings carried on 840 concrete-filled steel shell piles. New 16-E mobile paver aided in concreting piles and footings; mobile mixer with tower concreted deck, forms of steel being carried on heavy steel falsework girders

A HIGHWAY grade separation project and bridge embodying interesting features is under construction at New Orleans. Planned to carry Elysian Fields Avenue over the Florida Avenue Canal and several railway tracks, the project is being built by the New Orleans Railroad Terminal Board, William G. Zetzmann, chairman, as agency for the city of New Orleans. It is part of the city's passenger terminal and grade separation program now under way. G. A. Heft & Co., consulting engineers, supervised construction.

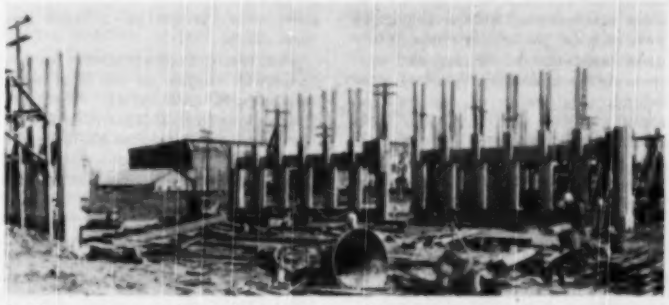
Contract for the multi-lane 1496-ft. long grade separation project was awarded at approximately $1,400,000 to R. P. Farnsworth & Company, Inc., which expects to complete the job this year. The structure will provide two 36-ft. roadways with 2-ft. separation and a 5-ft. walk and handrail on either side.

The structure consists of alternate rigid frame spans with cantilevers at either ends, between which simple spans are suspended. The rigid frame spans are fully hinged at footings. Thus the effect of single rigid frames is secured for a multiple-span structure, making it feasible to capitalize the structural economy of the rigid frame and at the same time provide for the possibility of unequal settlement along the bridge. The twenty spans are founded on long piling, there being 40 Raymond concrete-filled piles in each footing.

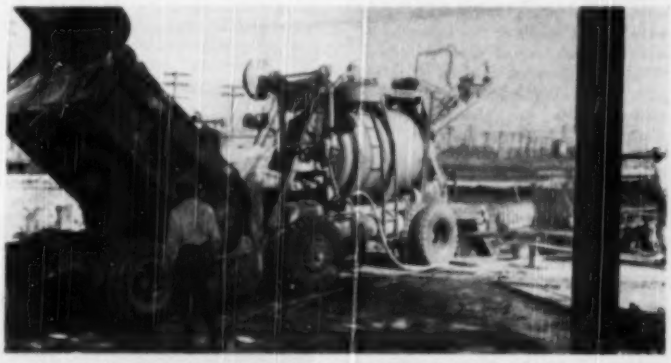
20 Piles per Day

The piles numbering 840 in all range from 75 to 105 ft. in length. Piles were driven by the Raymond Concrete Pile Company, acting as subcontractor. The Raymond firm used a 7-drum 80-hp. steam rig with 120-ft. boom, mounted on double H-beam

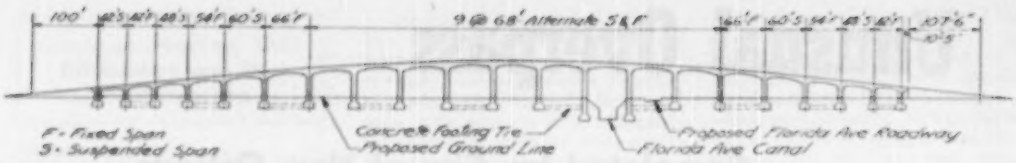
★ Paver boom was swung aside and concrete placed for this footing by crane and drop bucket



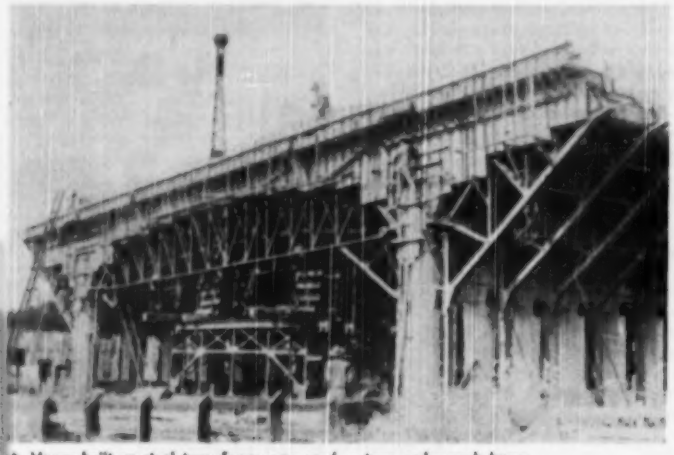
★ Close-up of a typical bent showing streamlined design. Photos by A. J. McCorkle.



★ Concrete for shell piles and pier footings was placed during 1948-49 winter using rubber-tired mobile paver (Koehring 16-E)—this new unit's first project


100' 80'S 66'F 80'S 56'F 60'S 66'F
9 @ 68' Alternate S & F
66'F 60'S 56'F 80'S 56'F 107'6"
F - Fixed Span
S - Suspended Span
Concrete Footing Tie
Proposed Ground Line
Florida Ave Canal
Proposed Florida Ave Roadway

★ Profile of the Elysian Fields Avenue Overpass



★ Heavy built-up steel truss forms were used, a truss under each beam

skids and rollers. Reinforcing cages were set in the shells immediately upon completion of driving and concrete filling operations followed close behind, progressing at the rate of about 20 piles per day. The boom of the paver, extending laterally out over the piles, permitted this progress without interfering with pile driving operations.

Concreting for the footings was mixed and placed in part using a new Koehring 16-E Twinbatch paver (the first such unit to be placed on a project). The existence of two old roadways flanking the new structure on either side aided the substructure work. Most piling and footing pours were within reach of the paver boom, working from one of these roadways. Where the distance was too great the paver deposited concrete in a drop bucket, which was picked up by a Koehring No. 601 motor crane. The 16-E paver and the crane were used for all of the substructure concreting.

Concrete materials for footing pours were batched into three-compartment dump trucks from a plant near the job. Two trucks working on a short shuttle delivered 10% oversize batches at the contractor's initiative. The Farnsworth Company subsequently moved the 16-E unit to a small street paving job nearby, where it delivered 35 cu. yd. per hour or the limit that could be supplied with six 3-compartment dump trucks on a short run from source.

The entire superstructure, except the lower section of the legs, were formed with steel forms. The Contractor employed a Mixermobile with tower attached to raise the concrete to the pouring level and discharged into a stationary hopper. The concrete was transported to its place of deposit in Georgia buggies.

The steel forms were designed so that sections could be removed to fit the varying span lengths. The forms were supported by trusses, one for each longitudinal girder, which in turn rested upon the footings. The upper chord of the trusses formed the soffit of the longitudinal girder.

The completed overpass was dedicated in January by Mayor deLesseps S. Morrison as the first unit of the far reaching grade elimination program completed under the direction of the New Orleans Railroad Terminal Board. Immediately following the dedication ceremony the structure was opened to public use. Although the approach roadways let under a separate contract are not completed, two-way traffic is using one-half of the bridge.

H. B. Shepard was general superintendent for R. P. Farnsworth & Company, Inc., with A. J. Combe, job superintendent. M. Q. Turner was resident engineer.

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All Kentucky state highway department employes have been asked to help traffic safety by reporting hazardous conditions seen during their travels, according to a directive by state highway engineer D. H. Bray.

●

Stripes Warn of Low Head Room

Safety Suggestions: Railroad Bridge Girders over U.S. 5, East Hartford, Conn., striped with reflectorizing material by the Connecticut Highway Department markings crew. The striping over both approach lanes amplifies the delineation of width and clear height available.

Triaxial Testing: Its Adaptation and Application to Highway Materials

PART II—Use of the Triaxial Method in Road Design

By Chester McDowell

Senior Soils Engineer,
Texas Highway Department, Austin

VARIOUS procedures have been devised for the application of triaxial compression test results to rational methods of pavement design. Since many assumptions are necessary in order to apply such methods, a typical approach is given below to point out some of the uncertainties encountered.

1. Measure strength of materials.
2. Estimate traffic load stresses in pavement and subgrade.
3. Design pavement to prevent overstress or excessive deflection.

Regardless of the design method used, it is important that the strength characteristics of the soil be determined so as to be consistent with eventual road conditions. The results obtained in steps 2 and 3 above are dependent upon the theory of elasticity, Poisson's ratio and sometimes upon the modulus of elasticity.

Serious efforts are being made to limit pavement deflections by design methods dependent upon Young's modulus or certain secant moduli of the materials involved. We have found the various moduli of disturbed soils (including base and subbase materials) to be somewhat variable and therefore difficult to evaluate, whereas shearing strengths are more definite and can better be applied to this problem.

Typical Test Data

Fig. 1 shows the stress-strain results of triaxial tests for a typical, satisfactory, sand-clay subbase material in the left portion of the graph. It may be noted that the modulus of elasticity varies from 5800 to 11500 depending almost entirely upon the lateral pressure applied during testing. The same type of test results are shown in the right portion of Fig. 1 for a gravel base material which has been used as a fairly satisfactory base course material in the San Antonio area. The test results for this gravel follow the trend of those for the sand-clay in that the moduli of the gravel vary from 3600 to 9900 depending upon the lateral pressure applied during testing; however, there is a distinct difference in the ultimate strengths as shown by the stress-strain curves of these two materials. The stress-strain curve shown by the dotted line represents a typical flattening out of the slope within limits of proportionality when specimens are molded slightly wetter than optimum.

In this case the specimen was molded at a moisture content which was only 0.44 of one per cent above the optimum moisture content. The ultimate compressive strength of this specimen after curing, drying and wetting, and final testing, with an applied lateral pressure of 5.6 psi., is relatively close to the strength of the specimen molded at optimum moisture content, processed as mentioned above, and tested under the same conditions of lateral support, however, the moduli of these specimens, which were treated identically in all respects except for molding moisture content, vary from 4700 to 7400.*

The fact that moduli are highly sensitive to minor variations of moisture, density, and lateral restraint, plus the fact that some soils have moduli in excess of some base course materials (as shown in Fig. 1), led us to seek other criteria in the design of flexible pavements. The fact is that some of the flexible base materials with good shearing strengths do not always have high moduli of elasticity; their moduli are independent of their shearing strengths. Such materials include a multitude of locally produced base and subbase materials which are widely used in construction and maintenance. Therefore, it was necessary that test methods be adapted to the examination of these materials as well as to subgrade soils.

In view of the uncertainty of the previously mentioned factors, a design method based upon a comparison of reliable strength test data with suitable mathematical stress estimates, all correlated with service behavior, seems to be the logical procedure.

*For further interpretations relative to a study of moduli, see article written by the author for the Proceedings of 2nd International Conference on Soil Mechanics and Foundation Engineering.

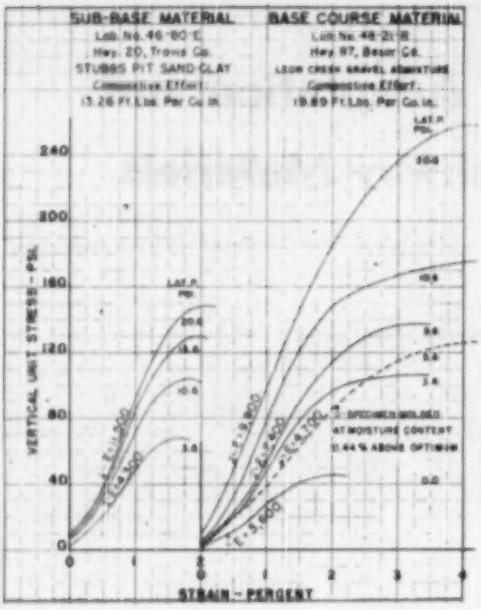
DESIGN METHOD DESCRIBED

Our approach to this problem may be briefly described as follows:

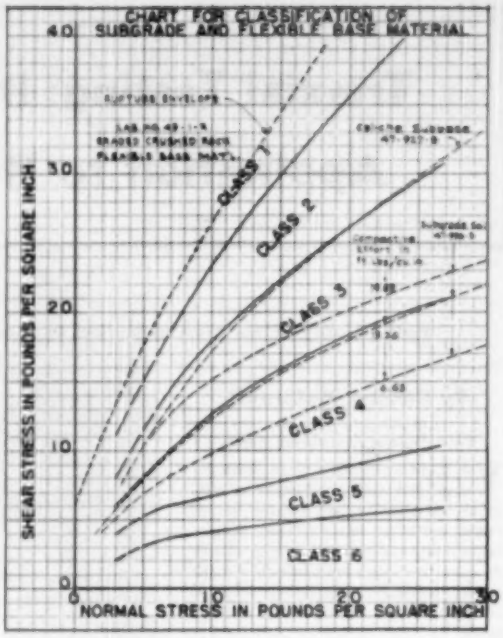
1. Test, by a rational procedure, base, subbase, and subgrade materials whose performance under average conditions is known.
2. Classify the materials according to their shearing strengths.
3. Estimate wheel load stresses at various depths by methods that will indicate stress envelopes whose critical portions are consistent with the shearing strengths of materials of known performance. In order to do this a number of assumptions for average conditions were made and are as follows:

a. A wheel load of 8000 lb.
b. A unit tire pressure of 90 psi.
c. Radius of loaded area = 5.3 in.

This is the second in a series of three articles. Part II is written specifically to show how the test results obtained as described in Part I are applied to the pavement design problem. Methods of design are discussed in general and a specific example of design for an actual project is given. The value of compaction of the subgrade and the use of local subbase materials are considered in selection of depth of flexible base. Part I was published in February 1950 ROADS AND STREETS. *Part III will appear in April. Reprints of the series will be available at 50c per copy, discount for quantities of over 10 copies. Address, Editor,* ROADS AND STREETS, *22 W. Maple St., Chicago 10, Ill.*



★ Figure 1



★ Figure 2

d. Tangential stresses = 45 psi, or coefficient of friction = ½.

e. A modified version of the elastic theory wherein the flexible pavement has zero tensile strength and the pavement ahead of the load acts as a free body which absorbs all load in the form of compressive stress.

f. Poisson's ratio = 0.5.

g. The weights of surcharge materials expressed as stresses were added to the normal stresses.

4. Compare envelopes of shearing strength (from 2) with envelopes of stress at various depths (from 3). For materials whose service record is known, the envelopes of strength and stress *should* coincide at a depth which experience indicates to be the required depth of cover, and probably *would* do so if base and subgrade were of equal stiffness. However, this does not occur because base materials nearly always are stiffer than subgrade soils. A correction is necessary. The depth at which strength and stress envelopes actually coincide is to be multiplied by the factor 0.85, called the stiffness ratio. Experience indicates that this is the proper factor with the great majority of flexible base materials. If the base material is cemented, other stiffness ratios may be required, or possibly even an entirely different method.

Use Stress Envelopes

5. Prepare a pattern of stress envelopes in the form of a shear diagram for the assumptions described in 3a. to g., with depths corrected as in 4, from which required depths of flexible base may be estimated for subgrade or subbase soils, by interpolation for those soils not previously correlated, and by extrapolation for heavier design loads.

6. To calculafe depth of base values for heavier loads of 12,000 and 16,000 lb., multiply the depths required for 8,000-lb. wheel load by the ratio of radii of the loaded areas, i.e., 6.5/5.3 for 12,000-lb. wheel load, and 7.5/5.3 for 16,000-lb. wheel load.

7. Prepare an appropriate table of pavement thicknesses required for various wheel loads based on the previously mentioned diagram in 5 above. After the table is prepared, depth values may be removed from the shear diagram which is then used only for classification. Such a method involves the use of a relatively low factor of safety against ultimate shear. Therefore, where traffic is very dense or produces braking stresses at intersections, an additional 2 to 4 in. thickness of pavement and/or surfacing are indicated. See foot note in Fig. 3.

Table for Interpretation of Classification of Subgrade and Flexible Base Material

Class of Mat'l.	General Description of Material	Depth of Pavement (Base and Surfacing) 8,000 lb. Wheel Load	12,000 lb. Wheel Load	16,000 lb. Wheel Load
1	Good flexible base material	Good—light bituminous surfacing acceptable.		
2	Fair flexible base material	One to four inches of bituminous surfacing or a stable layer of class 1 material covered with a good light surfacing.		
3	Borderline base and subbase materials	4–10"	5–12"	6–14"
4	Fair to poor subgrade	10–16"	12–20"	14–25"
5	Weak subgrade	16–21"	20–26"	23–30"
6	Very weak subgrade	21"+	26"+	30"+

Where braking stresses occur frequently, such as in dense traffic or at stop signs, additional depths of at least 2 to 4 inches of pavement and/or surfacing are indicated.

★ Figure 3

APPLICATION OF METHOD

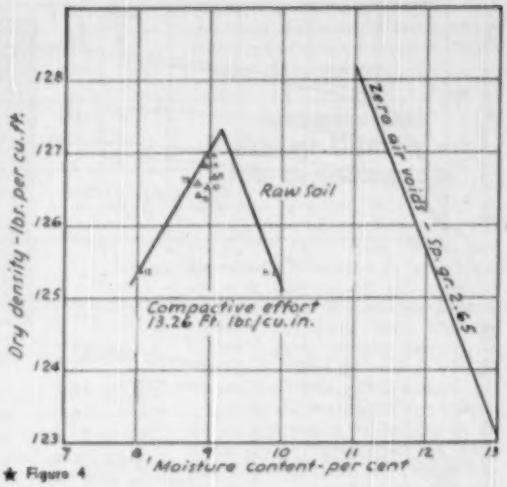
After Mohr's envelope of failure has been determined, as described in Part I, it is superimposed on Fig. No. 2. On the chart, provision has been made for six classes of soil materials. Having the classification of the material and the effective traffic load anticipated in the design, the position for the placement of a given material in the highway subgrade, subbase or base is obtained from Fig. 3. It may be desirable to interpolate between the limits shown for any given class, depending upon the position of the rupture envelope with respect to the boundaries of the class. These thicknesses are intended to result in a service life of many years' duration. The depths shown for Classes 4, 5 and 6 probably will be controversial. For

roads in soil areas which are subject to high volume change, the depth of pavement is dependent upon thickness of underlying clay layers and the extent to which shoulders, slopes and subsoils are protected from moisture fluctuations, as well as upon the strength of soils.

Heaves or dry weather cracks in pavements are frequently underlain by firm soils, which indicates that strength of soils under normal conditions is not the sole factor involved. Many engineers prefer to use stage construction in these areas and, with the intention of re-working the base occasionally, would select somewhat thinner depths than are proposed.

This approach is advocated by those who do not believe that any pavement will remain smooth on such soils. In the case of roads whose grade lines are not fixed, this approach has merit, but for primary roads it should be limited to a few areas of highly plastic marls whose nature, depth and environment bring about unavoidable, excessive movements due to volume change.

If stage construction is to be employed, the design depth should be not less than approximately 70% of the depth shown in the tabulation unless the life expectancy of the pavement is below ten years. The design of land service (FM and RM) roads, for which funds are limited, probably will have to be based on short life expectancy factors in many soil areas. It is conceivable that such under-designed roads might amortize themselves by service to the public within a three year period but *a three year life expectancy is an unsound design criterion*. Such roads may be partially justified from an economical standpoint but greater economy may be realized by the construction of more permanent roads. If our main highways were built on the basis of amortization alone, they would constitute a continuous project because many of them would pay for themselves in service in less than one year's time.

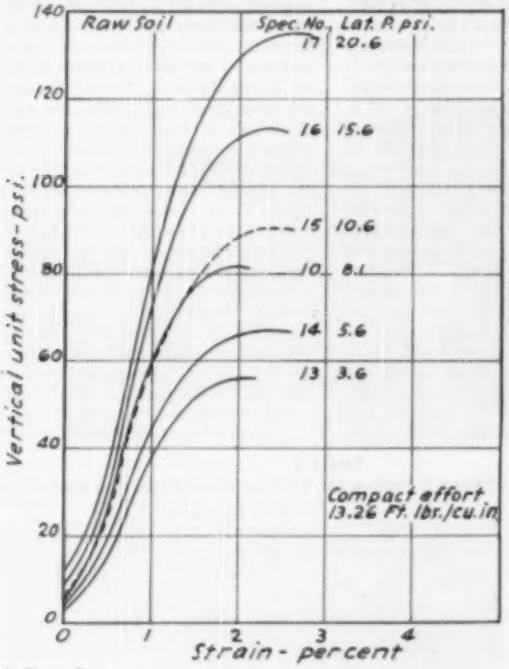


★ Figure 4

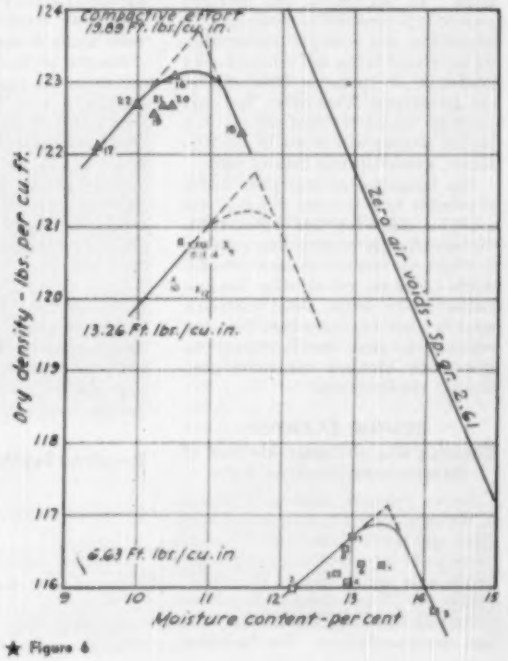
Design Wheel Load

The 16,000-lb. wheel load requirements are used for the design of expressways or heavily traveled interregional and primary highways. For urban expressways with fixed grade lines it may be desirable to increase the design load of 16,000 lb. some 25% to 50% in order to meet future road conditions. The required depths for heavier loads can be estimated by multiplying the required depths in Fig. 3 by the square root of the ratio of the wheel loads in question. Requirements for the 12,000 lb. wheel load are most commonly applied to the design of relatively important medium traffic highways. Adequate flexible base depths for other less important highways, including RM and FM roads, can be determined by use of 8,000-lb. wheel load requirements.

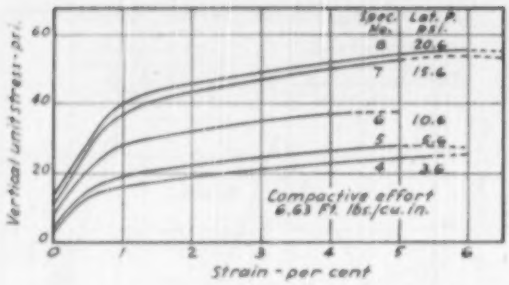
For airport design or for any other



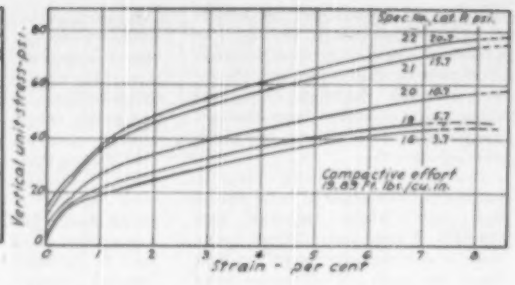
★ Figure 5


Compactive effort
13.89 Ft. lbs./cu. in.
13.26 Ft. lbs./cu.in.
6.63 Ft. lbs./cu.in
Zero air voids - Sp. gr. 2.61
Dry density - lbs. per cu. ft.
Moisture content-per cent

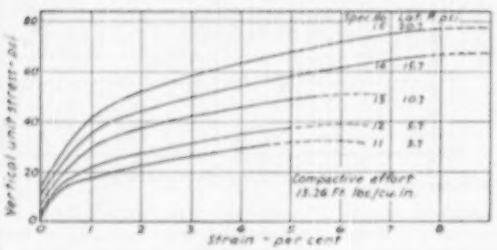
★ Figure 6



★ Fig. 7—Lab. No. 47-936-E; Hwy. 29 Refugio Co.; Sta. 905+00 to 1270+00



★ Fig. 8—Lab. No. 47-936-E; Hwy. 29 Refugio Co.; Sta. 905+00 to 1270+00



★ Fig. 9—Lab. No. 47-936-E; Hwy. 29 Refugio Co.; Sta. 905+00 to 1270+00

situation in which different design loads are indicated, the chart shown here would be applicable, but it would be necessary to formulate a new interpretation table based on service behavior of materials under the altered conditions.

The number of triaxial tests required can be reduced materially by the preparation of a soil profile based on soil constants, geology, and U. S. Department of Agriculture soil survey maps. In the use of the proposed method it is intended to determine the compaction and strength characteristics as related to the soil constants and gradation of materials from similar soil formations. Thereafter, the most practical means for field control on a specific project will be use of soil constants, gradation and density tests.

The foregoing interpretation makes it possible to determine which of the available materials are suitable for the construction of subgrade, subbase, and base courses and to determine the limits of initial construction requirements under which these materials must be placed in order that they may continue to serve the functional requirements of their respective positions in the structure.

DESIGN EXAMPLE

Showing Use of Design Method of Determining Depth of Base

As an example, consider a section of an important highway where stop signs and heavy traffic are not anticipated and from which samples of subgrade soils and a sample of a local, caliche soil subbase material have been submitted with the request for tests and recommendations. The final base course is to consist of crushed rock to be shipped in by rail from a previously tested and approved source. See Fig. 2. Several subgrade soils were submitted, but, for the sake of brevity, only one subgrade soil, representing only one section of the road, will be discussed in detail here. This subgrade soil (Lab. No. 47-936-E) has an LL=28, PI=15 and 98% passing the No. 40 sieve. The sample of caliche subbase material (Lab. No. 47-927-E) has an LL=19, PI=6 and 83% passing the No. 40 sieve. These materials were tested as outlined in Part I.

Results of moisture-density determinations are shown in Figs. 4 and 6. In Fig. 6 note that three different compactive efforts were employed to compact the subgrade soil. The stress-strain curves for the caliche subbase material are shown in Fig. 5. Stress-strain curves for the subgrade soil, compacted at the various compactive efforts, are shown in Fig. 7, 8 and 9. Mohr's diagram of stress was plotted for each material or condition, and the initial portions of each envelope of failure have been superimposed on the classification chart, Fig. 2. The caliche subbase material, 47-927-E, is at the top of class 3 and the subgrade soil ranges from the middle of class 4 to the lower portion of class 3, depending upon the density to which the material was originally compacted. Referring to Fig. 3, the caliche subbase material (top of class 3) would require from 4 to 6 in. of better material above it depending upon the wheel loading anticipated. The rupture envelope of the subgrade soil that was initially compacted to the standard AASHO density, lies within class 4 at approximately 4/10 of the distance between the upper and lower limits of the class, and should be covered with a minimum of $10+0.4(16-10)=12\frac{1}{2}$ to $14+0.4(23-14)=17\frac{1}{2}$ in. depending upon wheel load. When the subgrade soil is compacted at the intermediate density the material classifies at the top of class 4, requiring the minimum coverage for class 4 which is 10 to 14 in. depending upon wheel load. When the subgrade soil is initially densified by the highest compactive effort shown, the material falls within class 3 at about 8/10 of the distance between the upper and lower limits of the class and the minimum coverage required would range from $4+0.8(10-4)=9$ to $6+0.8(14-6)=$ $12\frac{1}{2}$ in. depending upon wheel load.

For convenience, the above men-

(Continued on page 88)

Table I
Required Depth of Base in Inches for Various Conditions and Materials

Base and Subbase Combination	Compactive Effort on Subgrade—Ft. Lb./Cu. In. 6.63			13.26			19.89		
	Wheel load in pounds 8,000	12,000	16,000	Wheel load in pounds 8,000	12,000	16,000	Wheel load in pounds 8,000	12,000	16,000
Crushed Stone (Only)*	12½	15	17½	10	12	14	9	10½	12½
Crushed Stone**	4	5	6	4	5	6	4	5	6
Dorsey Caliche*** (Combination	8½	10	11½	6	7	8	5	5½	6½

*Depths shown are the coverage required for: Subgrade Soil
**Depths shown are the coverage required for: Caliche Subbase Material
***Depths shown are the coverage required for: Subgrade Soil Minus Caliche Subbase

KNOCKIN' Out the Yardage

Montana Contractor Moved 1600 cu. yd. Gravel Daily

Using a shop-built conveyor-loader, among other things, the S. Birch & Sons Construction Company of Great Falls, Montana, set quite a pace in 1949 on a Wyoming road surfacing job. The project was a 9-mile section of the Sheridan-Beckton feeder road.

The job included a gravel base, consisting of 5 to 9 in. depth of select material; a 3-in. surface layer of 1-in.-minus crushed gravel; and a 1½-in. oil mat. Principal quantities: 54,020 cu. yd. of select pit-run gravel, 29,000 tons of crushed gravel, 108,000 sq. yd. of oil mat processing and 760 tons of cut back asphaltic road oils.

In addition to the loader the contractor worked with a Barber-Greene travel plant, a Cedarapids Master Tandem portable crushing plant, and Caterpillar D 8's and No. 12 motor graders.

Best day reported was 1600 cu. yd. of various materials moved by the loader in an 8-hour shift. Two D8 dozers pushed stockpiled or pit material to the loader. A select crew of patrol operators including Guy Haney, Owen Hill, George Bulman, and Larry Howe made short work of processing gravel, shaping shoulders, ditch work, aerating and laying down oil mat after material had been mixed with the travel plant operated by Bill Ille. Mechanic on the job was Don Tyler.

The conveyor loader was designed and built in the contractor's shop under direction of master mechanic Lynn Rintoul. Accompanying snapshot shows loader ready for moving to job with Rintoul standing beside his creation.

Project engineer for the Wyoming state highway department was Grover Powers, working under construction engineer William Templeton. Larry Mahon was contractor's superintendent, Virgil Haines shift foreman, Lee Miller gravel crusher foreman, Harry Peterson office manager.

★ The Birch shop-built loader

Scrapers Lick Rubbery Gumbo on Job in Minnesota

Gumbo—370,000 cu. yd. of it, ranging from sloppy to rubbery—is being moved by Moen Bros., Inc., Moorhead, Minnesota in rebuilding, widening and raising the grade of State Highway 81, extending north 13 miles from Shelly, Minn. The contractor is using two new electric control C Tournapulls along with 4 tractor-drawn Carryall Scrappers.

Located in the Red River Valley, the job site area is flat as a table. To obtain proper drainage and soil selection, however, there are over 1,000,000 sta.-yd. of overhaul. Hauls range from side borrow, with no haul, to a 7400-ft. one-way haul.

On a one-way haul of 2400 ft., the C Tournapulls were making a round trip every 7.3 min. . . . averaging 8.2 loads of 9¼ pay yards each in 60 minutes. They were pusher-loaded in .9 min. in 75 ft. by a D-8 tractor. The 2400 ft. haul was over the partially completed fill, quite rough and very spongy.

Average production to date of the two Tournapulls and tractor-drawn Carryall Scrapers is about 45,000 yd. per week, working one 11-hr. shift, 6 days a week.

Before coming on the Shelly job, the Tournapulls were driven over paved roads 44 miles from Fargo, N. D. to Detroit Lakes, Minn. They worked there in sand for another contractor, and then were driven 90 miles from Detroit Lakes to the present job at Shelly.

Portable Grease Rack

An easily portable, knockdown grease rack for servicing vehicles in the field is in the final stages of development for the Air Force, following extensive tests and recommended improvements. The rack may have extensive civilian use, it is said, where large fleets of vehicles needing periodic greasing are in use in relatively isolated areas.

★ Tournapulls were OK in mud, according to Ingvald Moen of Moen Brothers, Inc., Minnesota contractors

★ Fig. 1. As the first soil-cement road looked after 10 years of service

15 Years of Development in

Soil-Cement Methods

TWENTY-FIVE years ago the suggestion of mixing soil, cement and water to make a road or street base, would no doubt have been open to severe criticism. Today, however, there are over 65,000,000 sq. yd. of soil-cement in service in the United States, all built with soil, portland cement and water. These consist mainly of road, street, and airport bases with light bituminous surfaces. Other uses include miscellaneous paving such as storage areas, floors, walks, and erosion control structures in the form of ditch linings.

Fifteen years ago a one and one-half mile section of soil-cement road using moisture-density control fundamentals started off a new paving material to meet the secondary road and light-residential street paving problem. (Fig. 1).

The use of a blade grader pulled by a tractor was tried on the initial job. (Fig. 2). As the soil-cement mixture attained the optimum moisture content it began to stick to the blade instead of rolling around in front of it. A multiple-blade mixer drawn by a tractor was also tried but proved too slow and cumbersome. (Fig. 3). Disc-harrows showed promise of becoming efficient mixing tools. The center-cock type left objectionable furrows for water concentration during water application. In later work the offset, side-cock type of harrow proved satisfactory. (Fig. 4).

How Early Jobs Built

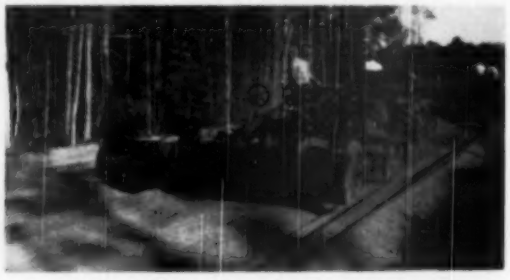
As each new project developed, new and different pieces of construction equipment were tried. At first the quack-grass diggers were employed, then the heavy duty stiff-tooth and spring-tooth cultivators were used. (Fig. 6). Rotary speedmixers with power takeoffs made their appearance about 1939 while today there is a self-propelled, self-powered 7-ft. speedmixer on the market. (Figs. 6 and 7).

About 1937 the offset disc-harrow, spring-tooth cultivator and 3 or 4-bottom gang plow constituted the most efficient and speedy mixing unit for soil-cement. As more projects developed, new mixing units and self-contained machines appeared on the market.

Traveling mixing machines, as they are generally called, soon appeared in several forms. One type had cutting rotors which mixed soil, cement and water in one continuous operation as it moved down the road. The soil required no windrowing ahead of the mixer and left the soil-cement mixture

(*Continued on page 56*)

★ Fig. 2. Mixing with a blade grader drawn by a crawler tractor on the initial soil-cement project using moisture-density control methods



★ Fig. 3. Multiple blade mixer on the pioneer soil-cement section near Johnsonville, South Carolina, in 1935

★ Fig. 4. Heavy duty offset disc-harrow used in preparing soil for cement spreading. Also efficient mixing device

★ Fig. 5. A spring-tooth cultivator usually used in conjunction with disc-harrow and gang plow to form a mixing unit

★ Fig. 6. An early type of rotary speed-mixer in service about 1939

★ Fig. 7. Two rotary speedmixers representing a new model now on the market. They are self-powered and self-propelled machines

★ Fig. 8. The first traveling mixer which mixed soil, cement and water in one pass. This appeared in 1938 on soil-cement construction

★ Fig. 9. A later type traveling mixer which mixed soil, cement and water in one pass, ready for compaction operations

★ Fig. 10. A traveling mixer which uses the windrow method of mixing soil, cement and water in one pass

★ Fig. 11. One of the mechanical cement spreaders on the market

The Local Road Situation

Long awaited report to Congressional Committee made public. Shows $894 millions needed for local road improvement, but suggests that 400,000 miles of little-used roads should be abandoned

LONG-AWAITED report of the Bureau of Public Roads to the subcommittee on roads of the Senate Committee on Public Works has finally been made public.

It expresses belief that most, if not all, of the funds needed to improve local rural roads could be supplied by local units of government themselves rather than through additional Federal aid. It reports that local governmental units "have a capacity to make greater contributions than they now make to the financing of local road needs" and places that "greater capacity" at between $100 million and $250 million annually. Such an additional contribution from local sources the report calls "both reasonable and possible."

And while the report cites existence of "an unquestionable need" for further improvement of secondary and local rural roads, it says there is "an equally unquestionable need" for a vast further improvement of primary rural highways and principal city arteries, which in point of cost far exceeds the needs of the lesser rural areas.

These are features of the report, requested by Senator Dennis Chaves, chairman of the parent Senate committee, after hearings last Spring on extension of Federal road aids to rural local roads had brought to light severe and apparently unreconcilable differences among groups testifying:

Federal Aid Restricted

It points out that hitherto the Federal contribution to rural roads below the level of a primary system has been qualified as available only for "principal secondary and feeder roads"; that systems of such roads have been designated in all states and now amount to a total of 393,000 miles, with no arbitrary limitation having been set upon their extent; that only the relative terms "principal" and "secondary" qualify the extent to which enlargement of the systems may be continued; and that the question now before the committee is whether the Federal contribution to secondary and local rural roads should continue to be so qualified and limited.

It makes an extensive report of present condition of local rural roads; mileages; jurisdiction over such roads; extent of surfacing (1,209,000 miles, or more than 48% of the total local rural road mileage, was surfaced as of June, 1949) and variations in that extent by states (six states reported less than 20% of local rural road mileage surfaced, fourteen 20% to 39.9%, nine 40% to 59.9%, ten 60% to 79.9% and only nine states with 80% or more so surfaced); outlines farm location in relation to all-weather roads (64% are on such a road, 10% within 1 mile, 9% from 1 to 2 miles, 8% from 2 to 5 miles, 4% over five miles, and 5% not reporting); and reports that the proportion of farms having direct access to all-weather roads was twice the proportion having telephones. (About 5½ million passenger cars and trucks were owned on a little over 5.8 million farms in 1945).

It declares that "the facts do not support" the contention that farmers do most of their driving on local roads and therefore derive little or no direct benefits from improvements

This summary issued by the American Institute of Local Highway Administration and the County Highway Officials Division of the American Road Builders' Association. Extra copies available by writing Ben Ostegren, Manager ARBA County Division, 1319 F St. N.W., Washington, D.C.

(*Continued from page 54*)
in a loose even condition behind it, ready for compaction operations. (Figs. 8 and 9).

Another type of mixer picked up soil and cement from a windrow then deposited it in a windrow after water had been thoroughly incorporated. (Fig. 10). A third type of traveling mixing unit used 2 to 3 machines in tandem to complete mixing operations.

Better Spreading Equipment

Interest in developing new mixing equipment led to new developments in spreading the portland cement ahead of the mixers. War preparations in 1941, which demanded temporary training areas almost overnight, brought about a mechanical cement spreader hitched to a 600-bag bulk cement truck. Another type capable of spreading an 11-ft. width was also developed. Later, another type using strikeoffs and a continuous belt proved satisfactory. (Fig. 11). The latest development in bulk cement spreaders appeared during 1949 and shows promise of becoming popular.

Compactors for soil-cement mixtures have remained practically the same during soil-cement developments. Various makes of sheepsfoot rollers for preliminary compaction and steel-wheel, tandem smooth rollers for final surface compaction make up this equipment phase.

The most recent development in soil-cement construction procedures is the immediate application of a bituminous cover on the completed soil-cement surface. This procedure is recommended provided the completed soil-cement surface is well compacted and very damp just prior to the application of the bitumen. Full coverage of the surface with the bitumen is essential when using this method. In some cases detours are not available and it will be necessary to apply some blotter type material such as sand or stone chips on the bituminous surface to prevent pickup by traffic.

Control Tests Important

The fifteen years of soil-cement research, testing and development brought out the importance of moisture-density control and wet-dry and freeze-thaw tests. These tests have been adopted as Standards by the American Society for Testing Materials and American Association of State Highway Officials. Thousands of miles of soil-cement roads and streets in service from 1 to 15 years in all climates have substantiated the dependability of these soil-cement tests.

As more federal, state, county and urban engineers and officials become acquainted with soil-cement procedures and performance, new developments will undoubtedly appear, especially in the construction field.

made on the limited mileage comprising the primary and secondary roads. (The report cites figures to show that in 1948, 83% of all travel in rural areas was on a combined system of state and Federal aid primary and secondary roads, consisting of about one-fifth of the total rural mileage, with average traffic volume on these roads—785 vehicles a day. The remaining four-fifths of the rural mileage was made up of local roads which carried 17% of all rural road travel and had an average traffic volume of only 43 vehicles a day).

It reports that of the 2½-million-mile local road total, only a fraction of 1% carries more than 1,000 vehicles a day; 10% carries more than 100 vehicles; 21% serves more than 50 vehicles daily; 17% serves between 25 and 50; 22% serves between 10 and 25 vehicles a day; and 40% of the total mileage is travelled by 10 or less vehicles daily. Of the total local road mileage, there are about 202,000 miles that have thus far been taken into the Federal aid system of principal secondary roads, the greater proportion of which serve the larger volumes of traffic. About 92% of the total mileage remains outside the Federal Aid Secondary System, and of that percentage 48% is used by traffic averaging between 10 and 100 vehicles daily, 4% carry more than 100 vehicles a day, and the remaining 40% carry 10 vehicles a day or less.

Many "Non Essential"

It suggests that in the 40% of total mileage carrying 10 cars a day or less, there are many roads that are "wholly nonessential". They include many "section-line" roads which the Bureau says "are in reality only rights-of-way, seldom used and recognized as public ways only by virtue of their legal reservation for road purposes." In the four states of Kansas, New Mexico, North and South Dakota alone such roads constitute some 97,000 miles, or about 27% of the total local road mileage in those states. The report recommends that "roads of this character, whose existence cannot be justified by any consideration of economic or social need, should be vacated as public ways and thus be permanently eliminated as an actual or potential drain upon the public highway revenues." It is estimated that there were 400,000 miles of nonessential roads which might be abandoned, and would reduce the mileage of all local roads from 2.5 million miles to 2.1 million.

Average traffic carried by 2½ million miles of local rural roads is set at about 56 vehicles per day, whereas the 8% of this mileage thus far taken into the Federal Aid Secondary System serves an average of 212 vehicles per day. Addition to that system of all local roads serving 100 vericles a day or more, or another 90 to 100-thousand miles, would provide a Federal aid system of about 700,000 miles. Of the 1.8 million miles remaining outside the Federal aid system, there would be little on which traffic volume would be as much as 100 vehicles a day, and not more than 225,000 miles which would carry as much as 50 vehicles a day. The average usage of the entire mileage outside the Federal aid system is estimated at about 24 vehicles per day.

The report gives details a state-by-state inquiry made during 1949 of the costs incurred by local highway agencies in the improvement of over 50,000 miles of local roads. Of the costs reported for 15,900 miles of construction, involving the placement of granular surfacing on existing pioneer alinements and including incidental grading and structures, 76% ranged from $1,000 to $3,000 per mile; 16% were between $3,000 and $5,000; 6% cost over $5,000 per mile and 2% less than $1,000 per mile. For 21,800 miles of improvements, involving placement of granular surfacing on adequately graded and drained roads and including grading and structures, 23% cost from $1,000 to $3,000 per mile, 20% from $3,000 to $5,000; 47% from $5,000 to $10,000 and 10% over $10,000. Improvement of over 12,000 miles of local roads with dustless surfaces cost more than $10,000 per mile in more than half of the cases.

$894 Million Needed

About 1.2 million miles of local roads are in need of improvement at the present time, and that such improvement will average about $6,000 per mile, or a total of $7.2 billion. To overcome present deficiencies within 10, 15 or 20 years thus would require an annual expenditure of $720 million, $480 million or $360 million respectively. And adequate level of maintenance performance would cost an average of $500 million. With the addition of administrative and engineering costs, estimated at 4% of the combined construction and maintenance expenditure, an average annual cost, exclusive of debt service, of $1,269 million, $1,019 million or $894 million in a 10, 15 or 20-year corrective program.

A "definitely increasing trend" is cited toward the support of local rural roads with state-collected revenues. In 1927, there was no state in which less than 40% of the revenue came from local sources. In 1937 there were 14 states, and by 1947 that figure had risen to 23. In the 20 year period from 1927 to 1947, the relative contribution made to the support of local rural roads by local units of government was cut more than half, from 81% to 39%. The Bureau says the failure of many local governmental units to sustain their share of the financial burden for local roads when state revenues have been made available "raises grave doubt of the depth of their interest in working out a solution of the financing problem."

The report charges that the efforts on the part of many local units to be relieved completely of financial burden, while demanding the right to exercise complete local autonomy in the expenditure of road funds, is "not only incompatible with sound principles of government but is an inordinate departure from any reasonable concepts of equity."

The report emphasizes the need for improvement of local road administration "to better the job of improving and maintaining local roads, the first need is better laws." Because of legislative deficiencies, the local units have been immeasurably more handicapped than have State highway departments. "With the removal of these handicaps, accompanied by provisions for more adequate administrative machinery, and with the aid of progressive and cooperative state highway departments, the local units of government can take their proper place as cooperators in the task of improving the country's roads."

The backbone of the State-local relations law should be a State-aid program managed by the counties or local units with State assistance in planning, establishing priorities of improvement, and selecting road systems, State approval of plans and programs, and adequate provisions to insure a minimum standard of performance.

Lack of Engineers. The report goes on to show the great variation in local road administrations, stating that engineers are in charge of road work in only 850 counties out of the 2800 reported. About 90% of that total number operate in 12 states. The county unit administration prevails in over 1900 of the more than 2800 counties.

The report in emphasizing need for engineering supervision of local road operations states that it should be required by law in all states. "Where feasible, each local unit should employ its own engineering services". Where not practical, the report suggests sharing of the services of an engineer by two or more units.

The report calls attention to the importance of maintenance operations stating that "nearly one-third of all highway expenditure is direct-

ed toward the purchase, operation and repair of mechanized equipment. The effective use of these mechanical aids is an essential of any effort to improve and maintain the large mileage of local rural roads within reasonable cost limits." In an adequate local road improvement program it is estimated that maintenance costs will amount to $500 million dollars annually.

Regional Meetings Held

In order to determine the sentiment of county and local highway administrators concerning Federal-aid for secondary and local roads, the County Division and the American Institute of Local Highway Administration sponsored meetings recently in New York, Atlanta and Chicago. Representatives from the Northeastern, Southern and Central states were in attendance.

Discussion centered around our county and local rural road problem, the present Federal-aid secondary program — its advantages and its shortcomings, the advisability or inadvisability of including another classification of roads within our Federal-aid system, and the possibility of expanding and extending our Federal-aid secondary program. Questionnaires were distributed to those in attendance and each question was considered in the discussion. Summarizing the information obtained from the questionnaires we find a preponderance of opinion in favor of some type of Federal-aid for the improvement of local rural roads. However, those in attendance were unanimous in their declaration that they were opposed to the creation of any new agency to administer a local road program.

While in the Northeastern District there was some sentiment for the Bureau of Public Roads dealing directly with the counties, the vote in the three meetings was more than 4 to 1 in favor of continuing the present pattern of administration with control centered in the Bureau of Public Roads and the State highway departments.

Concerning specifications and standards for construction it was agreed that they should not be lowered but that they might be simplified in order to cut administrative, engineering and construction costs. All of those in attendance at the three meetings concurred that any legislation affecting local rural roads should be continued as an engineering program. Rather than to establish a new local road program, representatives expressed themselves in favor of increasing the present Federal-aid secondary program. The increase they suggested varied from 50% to 100%. In the discussions considerable emphasis was put upon the need for greater cooperation between the three agencies participating in the road program, namely, the Bureau of Public Roads, the State highway departments and the counties.

There was considerable criticism of the present FAS program with some of the representatives declaring that there was too much red tape and that the State highway departments had arbitrarily altered standards to meet requirements above that of the established minimum. Representatives from some states also took exception to their State highway department's by-passing the counties in the administration of the Federal-aid secondary program.

In the Southern District meeting the county representatives were unanimous in the opinion that it would be beneficial for each State highway department to organize a secondary or rural road division to cooperate with the counties in the administration of any local road program. This opinion was also supported in the other two districts.

To Be Discussed

At ARBA's 47th annual meeting (March 6-9, Cincinnati) the report of the local road problem by the Bureau of Public Roads was the subject of discussion before the County Highway Officials' Division.

Senator Dennis Chavez, chairman of the Public Works Committee, heads panel and opened discussions. Representing the Bureau of Public Roads was A. C. Leonard, Chief of the Secondary Division and H. A. Radzikowski, Chief of the Maintenance Division. Several members of the Board of County Engineer Consultants to the Bureau of Public Roads and two or more other county engineers completed the panel.

Florida Employs Darkened Median Strip

Two features of major importance—traffic safety *and* economical maintenance—have been incorporated in the construction of the new Hillsboro highway, a federal-aid project leading into Tampa, Florida. As illustrated in the accompanying photograph, a 4-ft. side concrete division separates the opposing traffic lanes, this feature extending for a distance of three miles. This strip has been given a corrugated surface which, when driven upon, transmits a warning vibration to the driver. Also, in order that the division strip may be easily seen for long distances in advance, it was given a special treatment of penetrating material that would insure lasting color contrast. Kemiko stain was used to penetrate into the pores, becoming an actual part of the concrete.

The result is a black, permanent color designed to withstand heavy traffic and varying climatic conditions for a considerable period without need of further applications. This method of dividing and marking a highway is used by the Florida road designers to provide an element of separation without use of center curb. Brinson Construction Company, contractors; Florida state highway project.

●

Motorists in Chicago wrecked 275 light poles, 14 safety island lights and 89 stop lights on park district boulevards and parkways during 1949. According to park district electrical engineer F. D. Wyatt the replacement cost was $70,800. South side traffic caused the most damage, possibly because of more out-of-town drivers.

★ 4-ft. wide dark-concrete median strip on new road near Tampa, Florida

THE NEW YORK PEOPLE'S

"Voice from the Crossroads"

How to Build a Strong Good Roads Association—No. 2 of a Series

New York, a laggard in road construction in the first post-war years, has begun to step up its road building pace. Now a militant young "road booster" organization is after a $175,000,000 annual program.

By Chas. H. Sells

Executive Director
New York Good Roads Association, Inc.

"WE Want Good Roads!" That mighty chant is reverberating across New York State and is growing louder and louder with each passing day. Dismayed at the prolonged stepchild treatment given to the roads and streets which are so vital to their economic welfare, the people are shaking off their road-lethargy and are uniting in a demand for expanded and accelerated programs of road improvement by all levels of government within the state.

The sounding board for this popular appeal for roads which are safe, efficient and adequate is the New York Good Roads Association, a howling infant which celebrated its first birthday on March 9 of this year but which is already making its influence felt all over the state. Incorporated by the State as a non-profit, non-political, private membership organization, the Association is getting its primary strength from its grass roots type of organization.

"Grass Roots" Members

The New York Good Roads Association is a people's organization. Its slogan, "A Holler for a Dollar," means just what it says. All the Association can offer its members is a medium through which their mutual appeal for good roads can be coordinated and made more emphatic. To keep the cost of membership well within the average citizen's ability to pay, the annual dues have been kept at one dollar. Membership is open to all citizens who are at least 18 years old, who subscribe to the principle that good roads are needed and who pay their dollar dues.

This dollar not only makes the individual a member but it also entitles him to receive the Association's monthly magazine *Roads*, which features articles about the importance of roads to modern living, safety and also news of Association activities. In addition, that same dollar makes him a member of his own county chapter of the Association which is primarily concerned with matters involving local road needs and which receives twenty-five cents of his dues to finance chapter activities. Up to the present time, more than 20 county chapters have been organized. Formation of another twenty chapters is scheduled by May 1 and it is probable that each county in the state will have its own local chapter before the end of the summer.

The New York Good Roads Association came into being on March 9, 1949, after a group of outstanding citizens of the state met in Albany to ascertain what could be done to stimulate road improvement programs. These founders of the Association were aware of the growing inadequacies of the state, county and town roads and of the village and city streets. They had seen these all-important traffic arteries ignored in public budgets year after year. They realized that unless something were done to provide the public with good roads, there was a strong danger of the onset of an economic stagnation in the not-too-distant future.

Must Band Together

These far-sighted men realized that without an organized public there was little hope of obtaining for roads their fair share of the tax dollar. Scattered, individual pleas for such appropriations in the past were but whispers in the wilderness, and were brushed off with little or no consideration because of pressures from other organized groups seeking whatever money might be available for their respective pet projects. Roads, they argued, must have an organized "pressure group," too. They realized also that any Good Roads movement should be kept free of control by the

★ Two of the popular folders which the Association has issued to reach the "man on the street"

★ One of a series of lively cartoons used

so-called selfish interests, those who would gain financially from the success of the new Association.

In consequence, they built an organization to which *only individuals* could become regular members with the right to vote and hold office. As a further guarantee that control of the Association should remain constantly in the hands of the public which it represents, the founders of the New York Good Roads Association incorporated into its by-laws stipulations that no person employed by the construction industry and its affiliates could become elected officers of either the State association or any of its individual county chapters. And at the same time they put a similar prohibition on the election to office of members who were public employees lest the time might come when either the association or a publicly employed officer might face an embarrassing situation resulting from conflicting ideologies.

These founding fathers were realists in other respects, too. They knew that the dollar a year dues would not be sufficient to underwrite the expenses of the organization. For that reason they created a Sustaining Membership classification which is open to any individual, company, corporation, association or group which is interested in obtaining good roads and which might wish to *contribute* funds with which the association might finance its work. These Sustaining Members, and there are many, *give* whatever money they feel they wish to donate, but in return receive no rights or privileges whatsoever. Their ranks include private individuals, hotels, contractors, automobile dealers, civic associations, road construction material suppliers and others.

Organization Set-up

Directing the affairs of the Association is its Board of Governors, headed by a President, a Vice-President, a Secretary and a Treasurer. It also includes 12 Regional Governors, each of whom represents from two to eight counties of the state, and six Governors-at-Large, appointed by the President from the ranks of the Sustaining Members in order to give them a minority representation which will enable them to make certain the money they donate is spent wisely.

In establishing the twelve regions of the State, the Association tried to maintain a community of interest by having regional boundaries, in nine areas, coincide with those of the State Department of Public Works districts. The tenth State District, which includes New York City and Long Island, was broken down into three separate regions.

From an administration standpoint, the Association's day-by-day activities are under the jurisdiction of its Executive Director, who is assisted on staff level by Directors of Public Relations, Membership and Research. Completing the office staff are four stenographers and typists.

Field activities of the Association are directed by Field Representatives, who function under the immediate supervision of the Director of Membership. At present there are five persons so employed and there is every indication that each of the twelve regions will have its own Field Representative by the end of 1950.

These Field Representatives are responsible for the spade-work necessary for the formation of a county chapter, and then serve in a liaison capacity between the headquarters of the Association and the various chapters within their respective territories.

The Director of Public Relations is charged with supervision of all statewide Association publicity and also edits all Association publications. Since his duties confine him largely to the headquarters office he also doubles as office manager for the Association.

The Director of Membership is responsible for all activities leading toward the recruitment of additional members as well as supervision of the Field Representatives. The Director of Research is charged with duties normally associated with that office.

Many Talks Given

In addition, the entire staff is ready and willing at all times to address service clubs, civic groups and any organization which might be interested in learning of the importance of good roads. In this manner the staff has been able to spread the gospel of good roads in hundreds of communities throughout the state.

Headquarters for the Association are at 116 Washington Avenue, in Albany, only two doors from the State office building and one block from the State capitol. That office is equipped with a high-capacity addressing machine, mimeograph equipment and a postal meter, all of which expedite the handling of the thousands of pieces of mail which emanate from the headquarters in the course of a normal month.

The promotional work of the Association began within a few days after its formal organization. First came a decision to use the State colors of blue and gold as those of the association. In consequence, all of its letterheads, its brochures, by-laws, applications and all other printing follow that color pattern.

In its first brochure the Association asked, "Suppose There Were No Roads?" Next came one entitled "Squawk or Walk." Each was illustrated with appropriate cartoons to help tell the story of roads and their importance. A series of posters was published. So were the Association by-laws. Decalcomania transfers of the Association insignia were manufactured for free distribution to members so they might display them on their cars.

Next came the Association's first publication, a four-page newspaper, *Goodroadly yours*, which was issued during July, August and September, after which it was incorporated as a feature page in the Association magazine *Roads*, which, like its predecessor, is sent free to all members each month and also to all newspapers and radio stations in the State, to whom free reprint rights are granted for its entire contents.

Many newspapers in the State are now using articles from *Roads*. But of even greater significance is the fact that more and more papers are following up general articles in that magazine with specific features based on local road inadequacies.

Hammer Main Issue

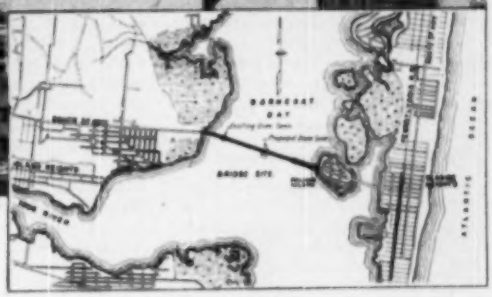
Roads is hammering away on road inadequacies in each issue. Last October, for example, it disclosed that nearly 20,000 miles of roads in the state are narrower than the Colonial Assembly decreed they should be in the ox-cart days of 1708. Subsequent issues have disclosed that, by the State's own admission, there are 25,000 danger spots on the State roads alone as indicated by the necessity of warning signs. Another issue disclosed the fact that 10% of the State road system must be posted to most trucks during the spring thaws because they are too weak to carry present-day traffic.

That the Association is meeting with popular acceptance is indicated by the steady growth in its membership and also the treatment which

BARNEGAT BAY BRIDGE —A LINK-BELT SPEEDER JOB!

6 USED BY
OLE HANSEN & SONS
ON MILE-LONG SPAN

Above: A K-370 and a K-25 operating on barge erecting steel on approach to bascule span.



Location of new bridge across Barnegat Bay, Ocean County, New Jersey.

Hansen's fleet of Link-Belt Speeders includes HC-90 truck-mounted Shovel-Cranes, as shown here, loading 20 ton plate girder 89 ft. long, on trailer for transporting to bridge site.

Crawler or wheel-mounted, the versatile Link-Belt Speeder is a machine of many uses, giving many opportunities for turning a good profit.

Outstanding suitability of Link-Belt Speeder Shovel-Cranes on large construction projects is well illustrated in the performance of 6 machines, on the Barnegat Bay Bridge. Ole Hansen & Sons, general contractors, have used only Link-Belt Speeders for the past 16 years, and now own ten.

Building 68 piers, including coffer dams, placing 19,000 yards of concrete, setting 10 million pounds of steel, and driving 104,000 lineal feet of timber pilings, were all done with Link-Belt Speeder cranes.

Power, speed, easy control, low operating costs, all show Link-Belt Speeders to be money-makers on every type of construction.

11,760

LINK-BELT SPEEDER

LBS

Builders of the Most Complete Line of
SHOVELS-CRANES-DRAGLINES

★ Another cartoon, part of the New York program

news of its activities is being given by press and radio. Press clippings for the first eleven months of the Association's history are equal to the contents of a full sized mail order catalogue.

Nor is that the only measure of the Association's acceptance. So far its aims, purposes and programs have been given the full endorsement of the New York State Federation of Labor, the New York State Rural Letter Carriers' Association, the New York State Conference of Farm Organizations, the New York State Society of Highway Engineers, as well as many other interested groups.

The New York Good Roads Association realizes that it is only a youngster in the field of membership groups. For that reason it does not attempt to operate as a lone-wolf. Rather it is seeking to coordinate its efforts with those of other groups having overlapping interests.

Work With Other Groups

An outstanding example of this has been the preliminary work which led toward the development of the Association's 1950 highway policy program. After formulating what we thought might be a workable plan which would solve New York's road problems we sat down with representatives of other groups having an interest in roads.

We discussed with them the highway problem as we saw it and then gave them a copy of our preliminary plan, inviting their comments and recommendations and suggesting a cooperative approach. This was done with labor, with farm groups, with industry, with commerce, with motorist groups and all others who were at all active in the crusade for the procurement of adequate funds for road construction.

Then followed a series of meetings at which each of these groups were represented. As might be expected, the original plan was not acceptable in its entirety to all of the conferees. There were even some who rejected the first draft in toto. But the conferences went on. Various compromises were suggested by one group or another, discussed and then adopted or discarded as seemed most appropriate. The end result was a program which conferees found worthy of support.

In consequence, the proposal may produce the ways and means for a stabilized program of New York road construction amounting to approximately $175,000,000 annually. This would provide the necessary funds for the rehabilitation of the existing primary highway network, the extension of improved road facilities into rural regions presently served by dirt roads only, the construction of the New York State Thruway by 1960, the elimination of hazardous railroad-highway grade crossings, the extension of various parkway systems and the development of arterial highways in cities.

None of this will be possible without a long-range financial policy. Our program should produce such a policy without causing financial strain upon the State treasury. In brief it calls for the *progressive earmarking* of gasoline tax revenues and motor vehicle registration fees over an eight-year period, the $175,000,000 ceiling being reached during its first year of operation through the issuance of the first portion of a series of bonds totaling $500,000,000 in that same 8-year span. After 1960 all revenues received from motorists, less administrative costs, would be used exclusively for road construction and the retirement of the $500,000,000 bond issue.

Through this approach the State can absorb the cost of the road program gradually without causing any impairment of State services or producing any undue tax burden upon the average citizen. Before it can become effective this proposal must be approved by both the 1950 and 1951 Legislatures and then be ratified by the people at the November 1951 elections.

Bound to Succeed

We feel that this program is one which the people want and for which they will vote. We feel that it has every reason to succeed because of the large number of organizations, representing over a half-million members, who are in back of it. It is not our program alone. Rather it is a program of all these interested groups which we are being permitted to introduce and sponsor on their behalf.

But legislation will not be our only matter of concern. We are alarmed at the high accident toll on our roads and are setting the stage for a year-round safety campaign aimed at reducing the number of accidents which leave misery and suffering in their wake.

We will also stay on the alert always to throw the spotlight of inadequacy upon those road facilities which are being neglected. Our magazine, *Roads*, is doing that each month as it publishes picture after picture of poor roads, of dangerous intersections, of hazardous grade crossings, weakened bridges, inadequate widths, short-sight distances, and other like situations.

Our county chapters are becoming a resounding board, a "Town Meeting" if you will, on matters involving local roads. Through their regular meetings these chapters will let their various local officials know, in no uncertain terms, of any dissatisfaction with road facilities and exert every possible pressure to bring about the desired correction.

When their problems extend beyond county limits the local chapters recommend appropriate action by the Association's Board of Governors which investigates and acts in accordance with its findings.

These county chapters are now competing with each other in a membership race which is an outgrowth of their own activities rather than something artificial and stimulated by the Association headquarters. Thus our membership is growing by leaps and bounds.

Our sleeves are rolled up for a whale of a job. But we're going to see it through. As one Boston newspaper columnist said, "The New York Good Roads Association is an infant with adult ideas." We're trying to put those ideas across.

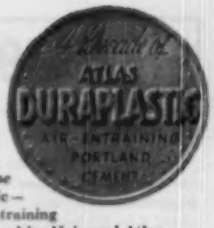
With every new member our voice grows stronger and stronger. The "Voice From The Crossroads" is sounding louder every day. What does it say? "We Want Good Roads!"

A Big Order!

The New York State Good Roads Association is in the midst of a fateful year which may see legislation shaped up for (a) a long-wanted auto-diversion amendment to the state constitution, and (b) a $400 million or possibly $500 million highway bond issue.

The state has long been far-and-away the worst offender in diversion of road revenues to non-road use. Politically the bond issue especially is appealing as a means of expediting Governor Dewey's Thru-way program along with meeting upstate local and urban highway needs.

Ten Years Ago...

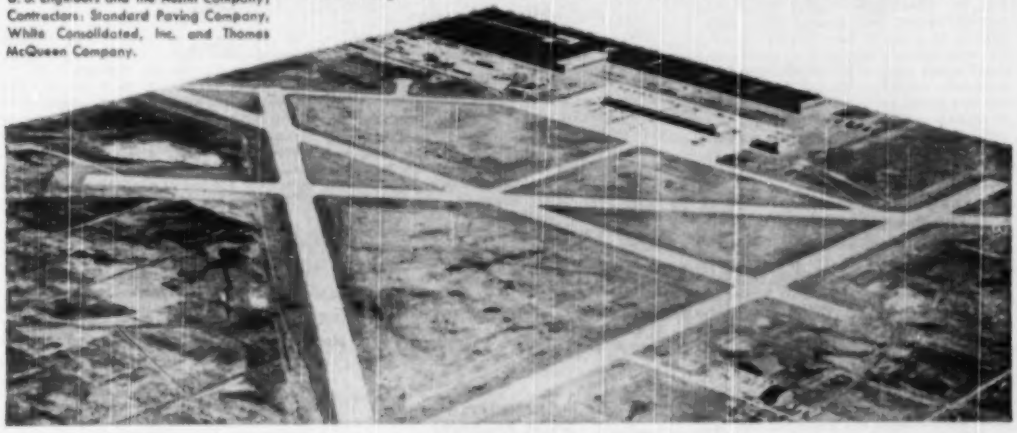


In August, 1939, this concrete test paving was laid in Second Avenue North, Minneapolis. The badly scaled section of roadway in the background was made with regular portland cement. The foreground section, *laid at the same time*, was made with Atlas Duraplastic—the first commercial use of the air-entraining portland cement originated and developed by Universal Atlas.

Both sections, subjected to the severity of ten Minneapolis winters and to heavy applications of de-icing salts, are shown just as they appeared in July, 1949—convincing proof of the characteristic durability of Duraplastic concrete, of its high resistance to freezing-thawing weather and the scaling action of de-icing salts. Longitudinal structural crack shows some ravelling. Note perfect transverse joint.

For example: O'Hare Field (formerly Douglas Airport), Park Ridge, Ill. Duraplastic used exclusively. Placed 1942-43. Despite heavy traffic of war and peace ...and the rigors of seven tough winters... paving remains durable and highly scale-resistant. Designed and supervised by U. S. Engineers and the Austin Company; Contractors: Standard Paving Company, White Consolidated, Inc. and Thomas McQueen Company.

Today concrete paving of all kinds prove DURAPLASTIC* makes better, more durable concrete at no extra cost



Veteran airport or famous highway, country road or city street, simple sidewalk or service alley...millions of square yards of concrete paving of all kinds...have been proving, since 1939, that Atlas Duraplastic air-entraining cement makes better concrete, more durable concrete, at no extra cost.

Better concrete because Duraplastic requires less mixing water for a given slump; makes concrete more workable, more plastic, more uniform. The more plastic mix dumps, spreads, screeds and finishes easily; permits finishing closer to the paver; allows earlier protection for curing.

More durable concrete because Duraplastic minimizes segregation and bleeding; fortifies concrete against freezing and thawing; renders concrete highly resistant to the scaling action of de-icing salts.

At no extra cost because Duraplastic sells at the same price as regular cement; calls for no additional materials, no unusual changes in procedure. Duraplastic provides the proper amount of entrained air by *intergrinding with the cement* the precise amount of air-entraining agent needed for satisfactory field performance. It complies with ASTM and Federal Specifications. *Send for NEW FREE BOOKLET, "A Decade of Atlas Duraplastic Air-Entraining Portland Cement." Write to Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.*

OFFICES: Albany, Birmingham, Boston, Chicago, Dayton, Kansas City, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis, Waco.

*"Duraplastic" is the registered trade mark of the air-entraining portland cement manufactured by Universal Atlas Cement Company.

RS 9-101

ATLAS DURAPLASTIC

TRADE MARK REG. U. S. PAT. OFF.

AIR-ENTRAINING PORTLAND CEMENT

MAKES BETTER CONCRETE AT NO EXTRA COST

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

1949 Major Equipment Developments

Concluding a summary begun in February Roads and Streets. Additional facts on products described below can be obtained from the manufacturer via postcard inserted at page 110. Each item is numbered. Just circle the corresponding number on the card and mail!

Miscellaneous

1

Tractor Snow Plough: Hough

Snow plow attachments, both "V" and reversible blade types, were made available for the 4-wheel drive, 1½ cu. yd. Model HM Payloader of The Frank G. Hough Co., 871 Sunnyside Ave., Libertyville, Ill. These plows readily interchange with the bucket. Features of this machine claimed to make it particularly effective for snow plowing are 75 H.P. gasoline or diesel power driving all four wheels; large pneumatic earthmover tires; instant, precise and powerful hydraulic power control of raising and lowering of the plow; powerful hydraulic brakes; utmost operator visibility; all-weather cab available.

2

Rammer: Barco

A gasoline-engine-powered earth rammer, hand held and strictly one-man in its operation, was developed by Barco Manufacturing Company, 1841 West Winnemac Ave., Chicago 40, Ill. Called the Barco "Pegson" Rammer, it is developed as an inexpensive and efficient means of compacting soils, especially in areas where rollers cannot reach. Abutment corners, backfill around culverts, pipe, bridge piers; subgrade and base areas in pavement repair work—these are some of the suggested spots of use.

Said to cover 1 to 1¼ sq. yd. of area per minute, the machine is designed for simple and easy operation.

3

Trencher: Cleveland

A new, small, compact model of the Cleveland "Baby Digger" trenching machine was placed on the market by The Cleveland Trencher Co., Cleveland, O. Known as the Baby Digger Model "92," the new machine is claimed to be especially adapted for gas, water and sewer house services, for telephone and power cable and conduits, for house and building footings and for airport, highway and farm drainage and irrigation. Chief advantages claimed for the new "92" are its small compact modern size. It has ditch capacities up to 5 ft. deep and 10 to 20 in. wide.

6

Diesel Electric Plant

A new 5000-watt A.C. diesel electric plant, Model 5DRP, announced by D. W. Onan & Sons, Inc., Minneapolis, Minn., is stated to combine unusually smooth operation and compact design and to produce surprisingly low-cost electric power. The secret of its smooth, vibration-free operation is in its prime mover—a new Onan-designed, opposed-two-cylinder, air-cooled Diesel engine. The result of long research and intensive study by Onan engineers on a two-cylinder opposed type Diesel engine, the Onan Model 5DRP runs so smoothly that it requires no bolting down, no special base. Integral shock mountings make it possible to operate this unit right on the floor. The plant's dimensions emphasize its compact design: Length—38⅞ in., Width—30¼ in., Height—26⅝ in. Air-cooling helps to keep its weight down to approximately 725 lbs., less batteries. Adaptable to portable applications, the 5DRP is available in 60- or 50-cycle and in all standard voltages.

7

Pulvi-Mixer: Seaman

The pulvi-mixers of Seaman Motors, Inc., 305 N. 25th St., Milwaukee 3, Wis., are now equipped with a selective speed transmission which provides a variation in rotor speeds best adapted to the job requirements. The addition of the selective speed transmission is stated to permit pulverization to a much greater depth; the mixing of aggregate of much larger diameter; better pulverization of stiffer clays and more thorough blending of stonier soils. The selective speed transmission, now standard on all motorized models, is claimed to extend the use of the pulvi-mixer to many types of construction activities that were heretofore impractical—such as deep treatment of sub-bases, doctoring of frost-boils, and the large scale construction of macadam roads and airport bases.

8

Cement Spreader: Hercules Steel Products

A new cement spreader, put in production by Hercules Steel Products Corporation, Galion, O., covers 5 to 10 ft. in width in any quantities required for soil-cement stabilized road building. Simple in operation, the machine spreads smoothly and evenly from one end to the other through the use of a single chain with cross bars which drag the cement over a tapered plate from the broad end toward the pointed end. The spreader is coupled to the rear of any dump truck; when the dump body is hoisted, the cement is fed into a 10-foot hopper provided on the machine. Its wheels furnish power for equal distribution of cement over any width to which the machine is set.

9

Trench Hoe Attachment: Hyster

Hyster Co., Portland 8, Ore., announces a ½ cu. yd. hoe front, addition to the dragline, clamshell, and crane features of the Hyster Hystaway, attachment for use with "Caterpillar" track-type tractors. Installation of the hoe front on the D7 and D8 Hystaway can be accomplished without major alterations to existing machines. The hoe dipper has a cutting width of 33 in., and for narrow ditching requirements an optional dipper of 23 in. width may be substituted.

10

Mechanical Dowel Installer: Flex-Plane

A machine that mechanically installs dowels and tie bars in concrete pavements, thus eliminating dowel holding devices, announced by the Flex-Plane Co., Warren, O., vibrates bars through the finished surface to their exact position and alignment within the slab. The machine is usually placed on the forms behind the finishing machine. It is a gas electric unit, with hydraulic lift controls. Machines are manufactured in two standard widths—adjustable 20 to 25 ft. for full width paving; and 10 to 15 ft. for half width paving.

11

Power Scraper Machines: Sauerman

A new series of power drag scraper machines was offered by Sauerman Bros., Inc., 588 S. Clinton St., Chicago 7, Ill., in sizes from 1/3 cu. yd. to 4 cu. yd. The machines are designed and equipped to afford automatic rapid shifting. The new units, known as Sauerman rapid-shifting scraper machines, give the operator, stationed at the scraper hoist, complete automatic control of shifting the tail end of the machine.

12

Rotary Screen Loader: Nelson

A new automatic rotary screen loader, introduced by N. P. Nelson Iron Works, Clifton, N. J., separates sand and gravel as it digs and loads into trucks. The unit consists of a Nelson rotary screen mounted on a self-powered Nelson Model Q-10 heavy duty bucket loader. In operation, the screen is synchronized with the bucket conveyor of the loader. Two chutes at right angles direct the flow of separated materials. When digging and loading materials that do not require screening a throw-out clutch enables the operator to disengage the screen and deflect material through the lower chute.

13

Trencher Attachment: Oliver

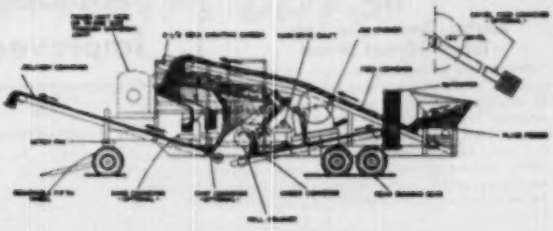
A new attachment for the industrial tractors of The Oliver Corporation, 19300 Euclid Ave., Cleveland 17, O., is the Ware hydro-trencher. The hydro-trencher can be easily installed on either a Model "77" or Model "88" Oliver Wheel Tractor. This unit has two hydraulic outriggers that provide a sturdy base for the entire combination and remove strains from the tractor while digging. The front of the tractor is held in place by counterbalancing weights. The boom is hydraulically operated and swings to either side allowing placement of earth in any desired location.

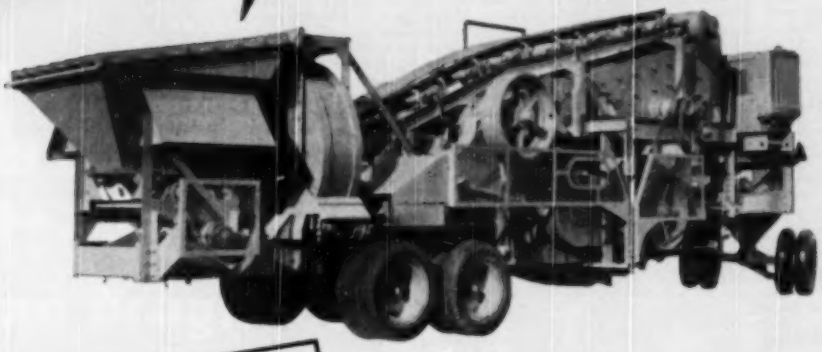
14

Arc Welder: Air Reduction

A new heavy duty arc welder was announced by Air Reduction, 602 42nd St., New York 17, N. Y. Known as the Wilson 36A "Yellow Jacket," this machine is built in 300 and 400 ampere sizes. According to Airco, the "Yellow Jacket" is especially suitable for pipe line work, con-

Follow this Flow of Material to PROFIT





880 JUNIOR GRAVELMASTER CONDENSED SPECIFICATIONS

- 1024 or 1036 Roller Bearing Jaw Crusher.
- 2416 Roller Bearing Star Gear Drive Roll Crusher.
- 3' x 10' Roller Bearing 2½-Deck Inclined Gyrating Screen.
- 6'-2" x 19" Rotevator.
- 24" Wide Conveyors. Sealed-for-life bearings.
- Plant Mounted Power or Side Drive through Universal joint.
- Countershaft for Main Drive permits choice of 1000 to 1600 RPM plant-mounted power units.
- Maximum use of V-Belt drives.
- Sand removal standard. Conveyor optional.
- Chip removal standard. Conveyor optional.
- Overall height—12'-6".
- Passes state weight limitations.

CAPACITY—60—90 yards per hour—1" based on 25% crushing with 1024 jaw crusher. For more than 25% crush, the 1036 is recommended.

MORE FOR YOUR MONEY

WITH UNIVERSAL "STREAM-FLO" ENGINEERING

UNIVERSAL'S "Scalping Deck" method of screening assures more effective screening, faster material flow. The heavy top "scalping deck" protects the finish deck from materials too large for the rolls and permits the lower screening area to be fully utilized. The screen is mounted at an incline giving faster separation for higher capacity, better gradation for meeting the most exacting specifications. No screenable material is carried over to choke the crushers. Material too large for the rolls is scalped to the jaw crusher. Only sized material goes to the rolls. This means greater capacity, less jaw and roll wear, lower horsepower requirements.

Only UNIVERSAL offers the superior advantages of "Stream-Flo" Engineering to give you more for your money in performance, in economy . . . in more tons per hour at less cost per ton. With all their extra value you don't pay a premium for a UNIVERSAL Gravelmaster. Made in 4 sizes with capacities up to 200 yards of -1" per hour. Investigate now. Write for complete details.

UNIVERSAL ENGINEERING CORP., division of PETTIBONE MULLIKEN CORP.

631 C Avenue N. W., CEDAR RAPIDS, IOWA — Phone 7105

4700 W. Division St., CHICAGO 51, ILL. — Phone SP aulding 2-9300

struction jobs or any work where ruggedness and durability are important factors.

15
Engine Generator Sets: International Diesel

Production of a complete line of fully-equipped and self-contained trailer-mounted electric generator sets in capacities ranging from 10KW to 85KW, was announced by International Diesel Electric Co., Inc., Long Island City, N. Y. These units, specially designed for on-the-job operation, can be easily moved from location to location. Available in both diesel and gasoline, 50 and 60 cycles, and in all standard voltages, these generator sets consist of an engine driving a generator, with an instrument panel containing all starting controls and switchgear, spring-mounted on a sturdy, pneumatic-tired four-wheel trailer.

16
Tractor: LeRoi

A new 25 h.p. Centaur CI industrial tractor was announced by Le Roi Co., Milwaukee, Wis. Featuring the Le Roi 25 h.p. D140 industrial valve-in-head engine, the CI power rating is claimed to be one of the highest for wheel type tractors in its class. The basic tractor design comes from the Le Roi Centaur highway and airport mower and retains the low center of gravity and short turning radius. A complete complement of attachments including loader, backfill blade, snow plows, rotary sweeper, utility boom, and winch, are available.

17
Hystaway Shovel Front: Hystaway

A ½ cu. yd. shovel front was a new attachment for the tractor-mounted Hystaway of the Hyster Co., Portland, Ore. Designed only for the "Caterpillar" D7 and D8 track-type tractors, the shovel front may be mounted on either new or used machines without major alterations. Utility use of the bulldozer is retained with the complete Hystaway installed, and it takes only one hour to dismount the Hystaway to allow full production bulldozer use.

18
Dragline Buckets: Pettibone Milliken

A series of featherweight perforated dragline buckets was added to the line of materials handling buckets and dippers manufactured by the Pettibone Mulliken Corporation, 4700 W. Division Street, Chicago 51, Ill. These buckets are of welded construction with 14% manganese steel for the lip and socket point type teeth, sheave, wire rope sockets and dump chain links. They are available in sizes from ⅝ to 2 cu. yd. capacities.

19
34 Ton Wagon

The new model FFD rear-dump Euclid, announced by The Euclid Road Machinery Co., Cleveland 17, Ohio, is powered by two diesel engines—mounted side by side—of 190 h.p. each for a total of 380 h.p. Each of these engines drives one of the rear axles through a torque converter and torqmatic transmission, thus eliminating the conventional interaxle power divider. There is no clutch pedal or manual shifting of gears—the operator can change to the proper gear under full power at any travel speed. Top speed with full 68,000 lb. payload is 25.4 m.p.h. Total braking surface is 1620 sq. in. The two planetary drive axles—with reductions at each wheel—are mounted on free floating springs. Payload capacity is 20 cu. yd. struck and 34 short tons.

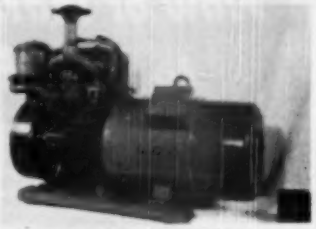
Announced in 1950—New and Improved Construction Products

25
New Hypressure Jenny

A new super-duty Hypressure Jenny steam cleaner designed and built to do the biggest cleaning jobs, and also for heat-transfer uses, has been announced by Hypressure Jenny Division, Homestead Valve Manufacturing Co., Coraopolis, Pa. As a steam cleaner, the unit is said to clean grease, grime and dirt from machinery and equipment 48 to 60 times faster than by hand methods. Its 300 gal. per hour capacity will operate from one to four cleaning guns. Full operating pressure is reached within two minutes from a cold start. In less than two minutes, it can be changed over for use as a heat generator, with heat output equivalent to a 25 h.p. boiler.

26
Electrical Plant

A new model electrical plant added to the line of Kato Engineering Co., Mankato, Minn., can be installed in freezing atmosphere. It is powered with a two cylinder, air-cooled engine. There is no radiator; consequently, no anti-freeze solutions to worry about. The engine is equipped with a high-tension magneto permitting hand cranking and there is no need for batteries of any kind unless



Model 45 HF W 4 Plant

electric cranking is desired which is also available. The generator has a rated capacity of 5 k.w. It is conservatively rated, consequently, it will start single phase motors up to 3 h.p. The plant is available with automatic transfer switch.

27
Light-Duty FWD Truck

A light-duty four-wheel-drive truck has been added to the line of Four Wheel Drive Auto Co., Clintonville, Wis. The new FWD, identified as Model LD, has a gross vehicle weight of 14,500 lb. Up to now, 17,000 lb. gross vehicle weight has marked the beginning of the FWD range, which extends up to 58,000 lb. It

(Continued on page 68)

20
20 Cu. Yd. Wagon: Woolridge

A new Terra Cobra Wagon Model TC-W14, announced by Woolridge Manufacturing Co., Sunnyvale, Calif., is available complete with 200 hp Terra Cobra Model TC tractor, or as wagon unit Model W14 only, designed for quick interchange with scraper unit on all models of Terra Cobra self-propelled scrapers. With a heaped capacity of 20 cu. yds., and 14 struck, the tapered bottomless hopper spot dumps to rear, or spreads to desired lift by moving back on roller tracks. Positive fore and aft motion of body is effected by air controlled cables reeved without reverse bends in such a manner as never to contact load.

21
Tractors: International

New, more powerful, "A" models of the International TD-18 and TD-14 diesel crawler tractors, were announced by International Harvester Co., Chicago, Ill. Both the TD-18A and TD-14A, have greater work capacities than previous models, and incorporate a number of new features designed for increased operator comfort and longer trouble-free service life. The heavy-duty TD-18A, second largest in International's line of five diesel crawlers, has 87 drawbar horsepower, compared with 80.5 in the previous model. The new model has six speeds forward.

22
Ditcher: Buckeye

The pilot model Buckeye 466 general utility ditcher has undergone refinements by Gar Wood Industries, Inc., Findlay Division, Findlay, O. The 406, one in a series of new Buckeye Ditchers, is of the boom type. All welded box section boom telescopes; lower section nests in upper section for 6 ft. digging depth. Fully extended boom digs to 8 ft. depth. Ditch from 17 in. to 24 in. wide can be rapidly cut. Bucket cleaner insures the removal of spoil and full bucket loads. Rooter point speeds are 91 ft. and 262 ft. per minute. Road speeds up to 3.38 m.p.h.

23
Bulldozer and Trailbuilder: Southwest

New bulldozer and trailbuilder equipment for use with Allis-Chalmers HD-19, HD-14 and HD-10 tractors was developed by Southwest Welding & Mfg. Co., 3201 W. Mission Road, Alhambra, Calif. These new units have eliminated the overhead "A" frame structure. They are now the radiator guard type mounting—extremely rugged and dependable. They can be furnished for either rear or front-mounted control units.

24
Concrete Curing Equipment: Devere

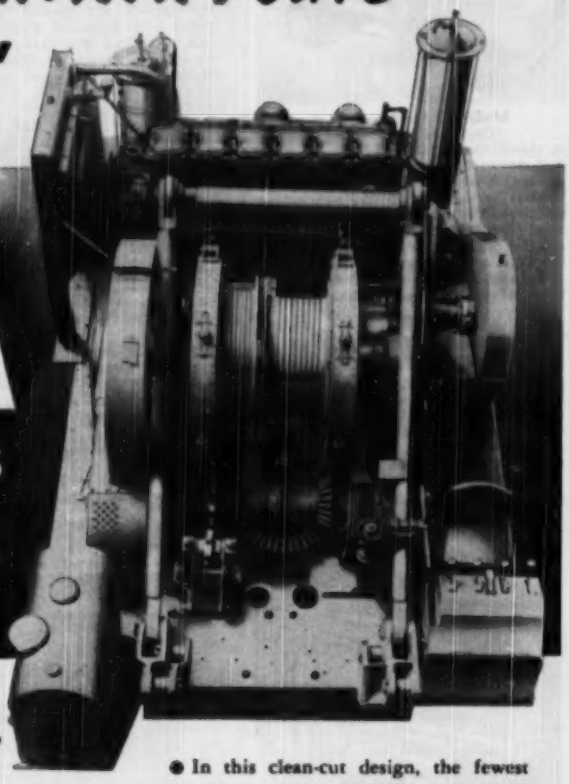
A sprayer unit, now in production by the Devere Co., Racine, Wis., is reported to cure concrete in strips from 6 to 20 ft. wide at a labor cost of $8 per mile. The Devere sprayer features a tank, pump and 2 h.p. gasoline engine mounted on an all-steel, two-wheeled chassis which is readily portable. Standard equipment includes an 8 spray-head unit which simultaneously treats a 6-ft. strip. Available as extra equipment is an adjustable boom which may be placed on bridges or carried by two men.

Built-in STAMINA *cuts*
"DOWN-TIME"

of

LIMA

Shovels, Cranes and Draglines



EXAMINE THE MAIN MACHINERY AND YOU'LL UNDERSTAND WHY!

● In this clean-cut design, the fewest possible number of shafts are required to transmit power from engine to dipper. Important bearings, including those in the drum, are anti-friction type. Large drums increase output and minimize cable wear. Permanently aligned shafts prevent chattering and grabbing of clutches. Extra-rugged construction of machinery base, truck and front end equipment provides ample strength to withstand heavy loads. These are only a few of the reasons why LIMA machines are making records of outstanding performance with *minimum down-time.*

The LIMA line includes Shovels ¾ to 6 yards, Cranes to 110 tons, and Draglines Variable. Rubber-Mounted units are available with ¾ and 1 yard shovels and 35 ton cranes. Offices in principal cities of the world.

Lima Shovel and Crane Division

LIMA, OHIO

OTHER DIVISIONS: Lima Locomotive Works Division; Niles Tool Works Co.; Hooven, Owens, Rentschler Co.

LIMA HAMILTON CORPORATION

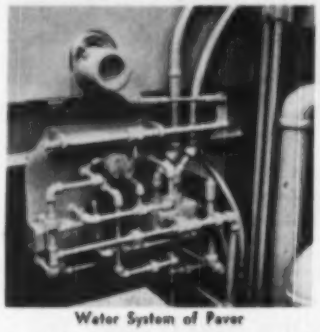
Model LD Light-Duty Truck

(*Continued from page 66*)

is stated that while the new Model LD will have its place in off-the-highway service, it also is said to have high efficiency on the road. Initial applications are scheduled for highway maintenance, municipal service, oilfield operations, general construction, telephone and electric-line construction and maintenance, industrial shuttle service and certain types of public transportation.

28
Automatic Water System for Paver

A fully automatic, hydraulically controlled water system is now standard equipment on Worthington-Ransome 34E dual drum pavers, of the Ransome Division of Worthington Pump and Machinery Corporation, Dunellen, N.J. The system is designed to simplify operation of



Water System of Paver

the machine and to assure a more uniform mix. The possibility of wet or dry batches due to carelessness is eliminated. The automatic system goes into operation when the skip is approximately 4 ft. off the ground, and closes the water valves completely when the required amount of water has entered the drum.

29
¼-Ton Utility Hoist

A new hydraulically-powered shop or truck hoist announced by Unit Manufacturing Co., Minneapolis, Minn., can be used on a 2-wheel tubular steel floor frame, or be quickly converted for use on truck beds, work benches and loading docks. It features fast hydraulic operation that will lift a ¼-ton load 77½ in. in 45 seconds and by using a short hookup, 2,000 lb. can be lifted 52 in. in 45 seconds. A double action, hand operated hydraulic pump powers the hoist.

30
Mowing Machine for Trees

The Bushwacker, "a mowing machine for trees," is now in production at the Fort Wayne, Ind., plant of the American Steel Dredge Co., Inc. This new machine weighs 14 tons, is mounted on a crawler-tractor unit and powered by a 168 h.p. Diesel engine. It is 10 ft. wide, 21½ ft. long overall and is stated to clear a swath 6 ft. wide at a speed of about 1½ miles per hour. In one pass over a densely wooded area, it is stated that trees up to eight in. in diameter and all undergrowth are reduced to small fragments and deposited upon the ground. The operating principle of the Bushwacker is relatively simple: 19½-lb. chrome manganese steel "flails" are at-

The Bushwacker

tached by chains to a revolving steel drum, mounted on a shaft at the front of the machine and partially enclosed within a heavy steel housing. The drum is powered by a 168 h.p. Diesel engine and revolves at 900 r.p.m. The 20 flails traveling at about 11,550 f.p.m. strike the growth with such force that the fibers are shredded. The trees or bushes are reduced to small fragments through further contact with the flails as the growth is carried back against the drum housing.

31
Meter Tests Air Entrained Concrete

A new meter for testing air entrained concrete, announced by Charles R. Watts & Co., Seattle, Wash., is claimed to make accurate tests in approximately three minutes. The meter follows the Klein-Walker application of Boyles Law, simplifies the usual testing procedure, using

Press-Ur-Meter

only about one tablespoonful of water, which is added on top of sample to insure accuracy. No adjustments for varying barometric pressures are necessary. A direct reading in percent of air is made. No computations or special training is required to operate. Low in cost, light in weight (19 lb.), capacity is ¾ cub. ft.

32
Pack Radio Set

A new FM 2-way pack radio announced by Motorola, Inc., Chicago, Ill., for use by construction companies, law enforcement agencies, fire protection departments, forestry services, and similar operators of extremely mobile 2-way radio equipment, incorporates a 16-tube receiver and an 8-tube transmitter into a compact 19 lb. radio station, 10½ in. by 13 in. by 4-5/16 in., that can be hand carried,

Motorola Pack Set

back carried, or used as a semi-fixed installation. The Motorola pack set, designed for operation in either the 25-50 mc. band or the 152-174 mc. band, is available in three versions: single frequency transmitter and receiver; two-frequency transmitter, single receiver; and dual transmitter ,single receiver. All are complete with batteries, antenna and microphone. This unit is designed for operation from pack set to pack set, with a nominal range of two to five miles, from pack set to mobile unit, with a range of from seven to ten miles with greater ranges experienced when operating with fixed base stations.

33
Packaged Steel Buildings

An extensive line of packaged steel buildings introduced by H. D. Campbell Co., Rochelle, Ill., can be erected by the purchaser without special tools or special skills. The line includes storage warehouses, garages and machine sheds. The buildings are available in widths up to 24 ft., in any desired length. Features

Campbell Packaged Steel Building

include paneled gables and die-formed eaves, U-channel draw type connectors, complete insulation. The side walls come in 8 foot wide sections, 6 or 8 ft. high. Doors and windows can be selected from standard window stock and inserted where desired.

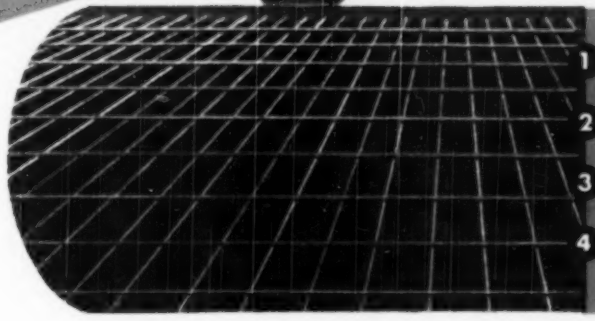
34
Portable Gravel Plant

A new gravel plant developed by Universal Engineering Corporation, Cedar Rapids, Ia., has three stages of reduction. Two screens are incorporated in the plant, (a) a scalping screen for the removal of all material not requiring crushing, (b) a grading screen for crushed material with rotovator and conveyor for operating a closed circuit. The

51 TONS COMING IN FOR A SAFE LANDING . . .

When 102,000 pounds of airplane hit an airport runway at 110 miles per hour, even concrete groans. That's why the CAA recommends reinforcing with welded wire fabric for safety and economy.

The use of welded wire fabric permits airport builders to use one inch less concrete and fewer contraction joints. The saving in concrete alone usually pays for the cost of the fabric and gives airport builders additional advantages as a bonus:



1. Fewer shrinkage cracks during curing.
2. Cracks that do occur are kept small.
3. Longer permanent life—improved performance.
4. Control of contraction and expansion stresses.

The highways leading to the field, and the culverts that carry off drainage, give longer, better service too, at lower cost when Clinton Welded Wire Fabric is used.

If Constellations don't use your field, remember that even 3,350 pounds of single engine impact at 55 miles an hour give your runway a beating.

Clinton Welded Wire Fabric exceeds American Standard specifications for every airport use . . . runways, taxiways, and aprons.

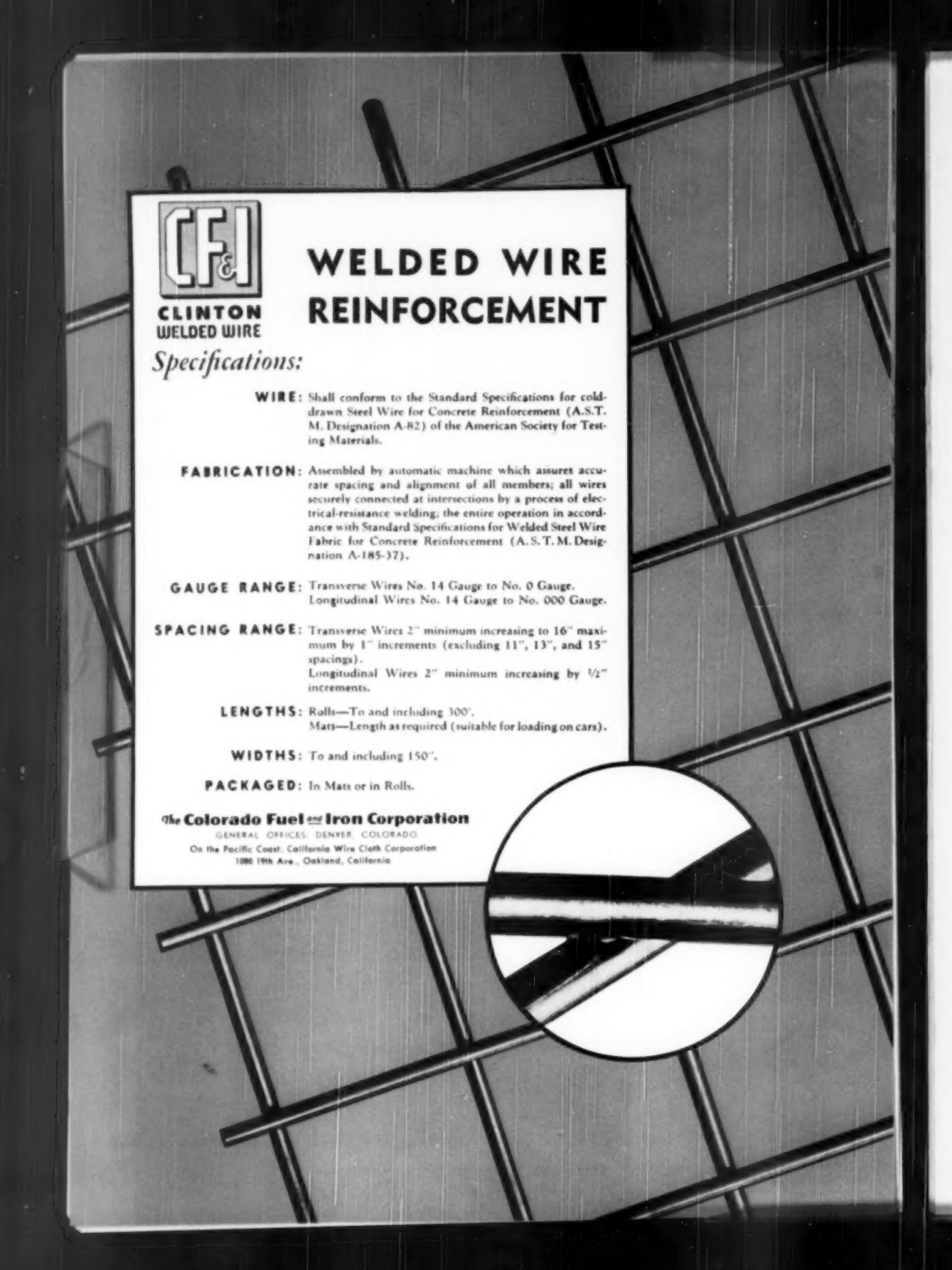
When you consider airport repair, expansion, or building, contact our nearest district office to learn how Clinton Welded Wire Fabric can give you more for your money.

OTHER CF&I PRODUCTS: Concrete Reinforcing Bars, Stucco Netting, Realock Fence, Wire Rope, Grader Blades and other Cutting Edges.

CF&I
2 SUBSIDIARIES

The Colorado Fuel and Iron Corporation
GENERAL OFFICES: DENVER, COLORADO

IN THE EAST: WICKWIRE SPENCER STEEL DIVISION, BUFFALO, NEW YORK
ON THE PACIFIC COAST: CALIFORNIA WIRE CLOTH CORPORATION, OAKLAND 4, CALIF.



CF&I

CLINTON
WELDED WIRE

WELDED WIRE REINFORCEMENT

Specifications:

WIRE: Shall conform to the Standard Specifications for cold-drawn Steel Wire for Concrete Reinforcement (A.S.T.M. Designation A-82) of the American Society for Testing Materials.

FABRICATION: Assembled by automatic machine which assures accurate spacing and alignment of all members; all wires securely connected at intersections by a process of electrical-resistance welding; the entire operation in accordance with Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement (A.S.T.M. Designation A-185-37).

GAUGE RANGE: Transverse Wires No. 14 Gauge to No. 0 Gauge.
Longitudinal Wires No. 14 Gauge to No. 000 Gauge.

SPACING RANGE: Transverse Wires 2" minimum increasing to 16" maximum by 1" increments (excluding 11", 13", and 15" spacings).
Longitudinal Wires 2" minimum increasing by ½" increments.

LENGTHS: Rolls—To and including 300'.
Mats—Length as required (suitable for loading on cars).

WIDTHS: To and including 150".

PACKAGED: In Mats or in Rolls.

The Colorado Fuel and Iron Corporation
GENERAL OFFICES: DENVER, COLORADO
On the Pacific Coast: California Wire Cloth Corporation
1080 19th Ave., Oakland, California

HUNDREDS OF HYSTAWAYS IN USE ALL OVER THE WORLD...

it's a DRAGLINE

it's a CRANE

it's a CLAMSHELL

it's a BACK HOE

...and now

THE HYSTAWAY is also a SHOVEL

HYSTAWAY—5 tools in 1—for mounting on all "Caterpillar" D8 and current series D7 track-type tractors (Dragline, Crane and Clamshell also applicable to D6.) On in 2 hours, off in 1.

And the newest tool in the Hystaway combination—a shovel front—makes Hystaway an even more valuable earthmoving machine.

The Hystaway Shovel Front possesses all of the advantages of a conventional shovel, *plus* full tractor mobility, *plus* an excess of power, *plus* an extremely fast swing, *plus* an unusually long reach.

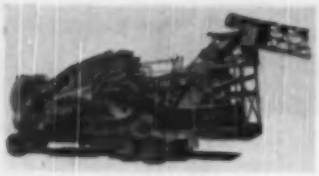
Hyster's line of 29 tractor tools (including the Hystaway) is sold and serviced by "Caterpillar" distributors everywhere. Current delivery. Write for literature.

½ CU. YARD CAPACITY

HYSTER® COMPANY

2995 N.E. Clackamas, Portland 8, Oregon

1895 North Adams St., Peoria 1, Illinois

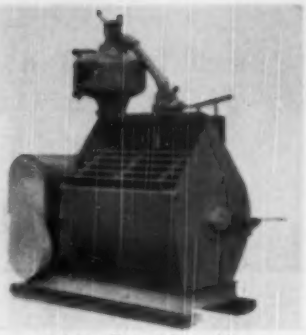


Pacemaker Plant

plant is primarily designed for use in gravel pits having a high percentage of oversize. The scalping screen delivers to the large opening primary crusher and the twin dual rolls only natural gravel that is oversize. Natural gravel and sand that does not need to go to the crusher is chuted to a side conveyor. The graded crushed gravel is delivered at the same side of the plant. Both conveyors may be arranged to discharge on a bin conveyor thus blending the natural and crushed gravel and sand.

35
Improved Plaster-Mortar Mixers

Important changes in design features affecting its 6 cu. ft. model 6-P and its 10 cu. ft. model 10-P plaster-mortar mixers have been announced by Kwik-Mix Co., Port Washington, Wis. Outstanding improvement on the smaller model 6-P makes it possible to reduce the overall width of the machine to 33 in. The machine's standard width of 44 in. is easily reduced by removing four bolts and telescoping the axle to the narrow 33 in. width. Easier cleaning of the mixer drum is another improved feature devised for the 6 cu. ft. Kwik-Mix mixer. Major improvement incorporated in the larger 10 cu. ft. Kwik-Mix mixer is the addition of an automatic water measuring tank. This is a self-cleaning device that delivers the correct volume of water into every batch of plaster or mortar.



Kwik-Mix Plaster-Mortar Mixer

ALLIS-CHALMERS SPECIFIES...
Velvetouch
ALL-METAL
STEERING CLUTCH FACINGS
ON THE NEW HD-19
Velvetouch cone clutch linings for power control units.
Steering clutch disc for HD-19.
THE S. K. WELLMAN CO.
WAREHOUSING CENTERS
ATLANTA
BOSTON
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The S. K. Wellman Co., of Canada Ltd.
WASHINGTON, D. C., OFFICE
Like other leading manufacturers of heavy duty tractors and earthmoving equipment, Allis-Chalmers specifies Velvetouch for dependable power control. Because the powdered metals, used in making Velvetouch clutch facings and brake linings, are scientifically processed to minimize chattering and slipping . . . insure smooth, positive action. Genuine Velvetouch lasts longer, too . . . for it's all-metal . . . can't rot in oil or "burn" like conventional material. Send for descriptive literature today.
THE S. K. WELLMAN CO.
1374 East 51st St., Cleveland 3, Ohio
FOR BRAKE AND CLUTCH USE Velvetouch
WORLD'S LARGEST MANUFACTURER OF ALL-METAL CLUTCH FACINGS AND BRAKE LININGS

36
Wagon Drill

A new wagon drill added to the line of Schramm, Inc., West Chester, Pa., is equipped with a 4 in. drifter and will drill holes at any angle, in any direction, to a depth of 24 ft. or more. It will drill flat holes at any point of 2 in. to 9 ft.

WDR-126 Wagon Drill

above ground. The air feed is continuous; it is never necessary to slide a guide shell or change the set-up by hand in order to get a full steel change. The drill will blow any hole clean. Another feature is a built-in twin jack-screw mechanism through which the U bar is raised or lowered to desired position.

37
Core Drill

A new core drill, announced by Acker Drill Co., Inc., Scranton, Pa., is designed to supply a light, compact, portable core drill of medium capacity for depths to 600 ft. Basically, the drill consists of a simple combination of a three speed, totally enclosed transmission with either a hydraulic feed or a screw feed drill head. The hydraulic feed gives the apparatus sensitive and instantaneous control of the rate of advance and the pressure on the bit, permitting the drill to be advanced as fast as possible in changing rock strata and also providing

Ford INDUSTRIAL ENGINE Service

where you want it

Equipment builders and users of industrial engines know that one of the most important keys to profitable operations is adequate and convenient service facilities.

Your product may be outstanding in design and performance, but if your owners have to search for service, wait long periods for replacement parts—you have a *real* problem on your hands.

When you specify Ford Industrial Engines as standard power for your equipment, you have your field service problem automatically solved. For Ford Industrial Engine Service is as near as the nearest Ford Dealer—clear around the world!

And that's just one of the 3 big reasons* why smart equipment builders know Ford Industrial Engines add a real profit-plus to their applications.

*** The other two? One—the *RIGHT* power; a choice of five great engines. Two—the *RIGHT* features—the latest developments of Ford's famed progressive engineering.**

★ **Ford "226" POWER UNIT**
6 cylinder, 226 cu. in. displacement
(Also available in open type power unit or engine assembly only)

Ford Industrial Engines are offered as complete power units, or as individual engine assemblies. Both are available with a wide variety of special attachments. They are made in the following types and sizes:

★ 120 CU. IN. 4 CYLINDER
★ 226 CU. IN. 6 CYLINDER
★ 254 CU. IN. 6 CYLINDER
★ 239 CU. IN. V-TYPE 8 CYLINDER
★ 337 CU. IN. V-TYPE 8 CYLINDER

For complete specifications, call or write

INDUSTRIAL ENGINE DEPARTMENT
Ford Motor Co., Dearborn, Mich.

Send me comprehensive literature about the new Ford Industrial Engine Power Units.

Name_____

Street_____

City_____

State_____

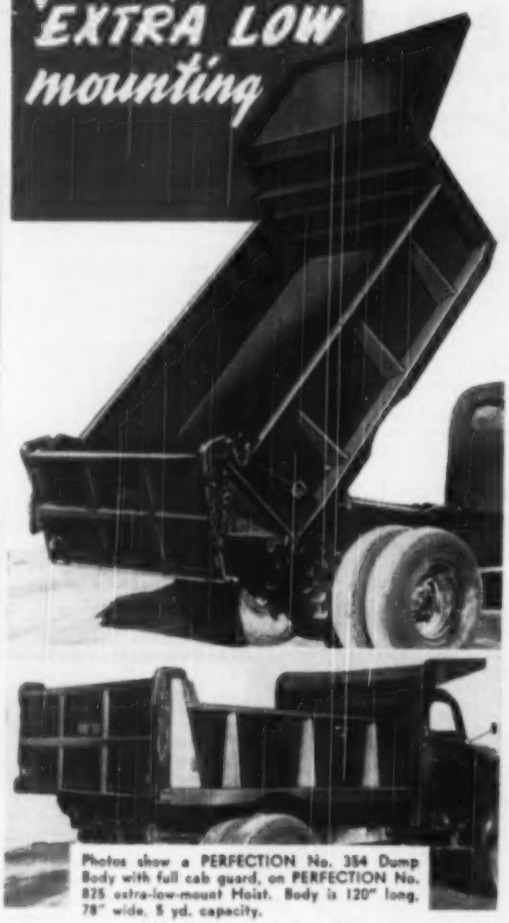
C

Clip and Mail This Coupon Now!

Industrial Engine Department
FORD MOTOR COMPANY
DEARBORN, MICHIGAN

YOUR JOB IS WELL-POWERED WHEN IT'S FORD-POWERED

PERFECTION
(THE NAME TO REMEMBER)
BODIES
& HOISTS
for regular or
EXTRA LOW
mounting

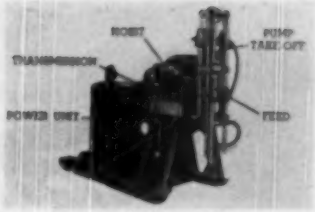


Photos show a PERFECTION No. 384 Dump Body with full cab guard, on PERFECTION No. 825 extra-low-mount Hoist. Body is 120" long, 78" wide, 5 yd. capacity.

Write for complete information

THE PERFECTION STEEL BODY COMPANY
Galion, Ohio, U. S. A.

PERFECTION
STAKE and DUMP BODIES
HYDRAULIC HOISTS
FOR ANY TRUCK
STANDARD or SPECIAL UNITS
IN ALL SIZES - FOR ANY USE



Toredo Core Drill

the uniformity of pressure necessary for the highest recovery of quality cores. On the other hand, the screw feed drill is somewhat lighter in weight and lower in cost.

38

New Fiber for Street Brooms

A revolutionary new fiber for winding rotary brooms was announced at the January Associated Equipment Distributors Convention in Chicago by the Modglin Co., Inc., Los Angeles, Calif. This fiber is Permene, a synthetic fiber developed by the company after three years of intensive research. Qualities claimed for Permene by the Modglin organization have far greater wear than ever obtained from any natural fiber, greater ease in manipulation (all water and steam baths heretofore necessary with old-style vegetable fibers are eliminated), imperviousness to water, lower labor cost in broom rewinding, and more efficient sweeping performance.

39

Admix Meter for Pavers

The development and availability of a new admix meter specifically designed for installation on either the Koehring 16-E or 34-E twinbatch pavers, has been announced by Koehring Co., Milwaukee, Wis. The attachment is also suitable for use in connection with batchers in ready-mix or central-mix plants. The admix meter is designed as a metering device for automatically measuring a predetermined quantity of a liquid air entraining agent into the concrete batch. Entirely mechanical, movement of the paver skip actuates the meter. Capacity of the admix meter is adjustable, from 1⅛ to 20 fluid ounces, in 1/10 ounce increments.

40

Viber Vibrators Improved

The latest improvement of the vibrators of Viber Co., Burbank, Calif., is a new clamp arrangement between the driving unit and flexible drive. This new Viber clamp, although similar in appearance to the old, uses a squeeze ring which does away with the slots milled in the old style clamp, thus producing a much stronger clamp. It is simple in design but has a positive gripping power.

41

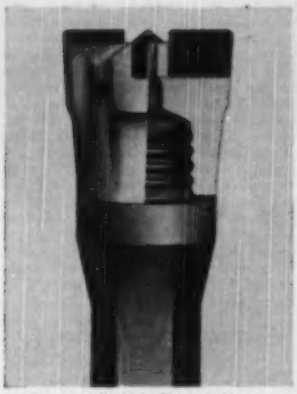
Cloth for Engineering Drawings

A new photo-sensitized cloth developed by the Eastman Kodak Co., Rochester, N. Y., eliminates the conventional negative step in making cloth reproductions of engineering drawings. Like other "Autopositive" materials, Kodagraph Autopositive cloth produces a positive copy directly from a positive original drawing. It may be handled in normal room light and is exposed on conventional blueprint or direct-process machines or a vacuum printing frame. The new cloth is highly translucent, assuring rapid production of quality shop prints, and may be drawn in on either side, using ink or pencil. It is available in 36- and 100-ft. rolls in the following widths: 20, 30, 36, and 42 in.

42

Attachment for Tungsten Carbide Bits

A new attachment developed by engineers of Ingersoll-Rand Co., 11 Broadway, New York, N.Y., is stated to be the only one now available designed primarily for use with tungsten carbide bits. The attachment is of the shoulder type employing a patented 38-degree reverse-buttress thread. It was developed particularly to resist shock and impact while still preventing slippage, excessive thread wear, or loss of drilling speed. The form, pitch, and size of the thread used have been selected so as to give both attachment and bit maximum thread life. The effect of the matching 38-degree surfaces in the bit and on the attachment is to cushion and absorb the destructive reciprocating and rotational forces that tend to ruin bit threads or to

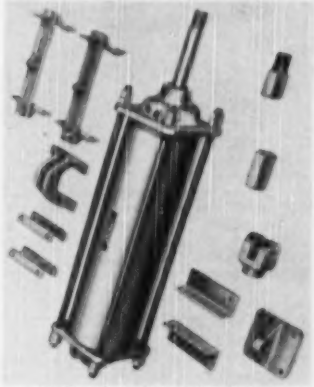


Tungsten Carbide Bit Attachment

break the threaded extensions on drill rods. According to the company, the threads on the attachment are designed to last for the life of the bit.

43
Air and Hydraulic Cylinders

A new line of air and hydraulic cylinders, known as the Medium Duty Series, is announced by Ledeen Manufacturing Co., Los Angeles, Calif. These cylinders are an addition to the line of Heavy Duty and Super Duty cylinders now being manufactured, which have found use in industries wherever straight line motion



Medium Duty Series of Cylinders

is used; for remote control operation, material handling, clamping or holding, and a multitude of other uses. Cylinders utilize tie-rod construction to give positive protection against leakage at joint of tube and head. Chevron packing is used to seal piston rod.

44
Low Hydrogen Electrodes

A complete new line of low hydrogen electrodes is now being produced by Harnischfeger Corporation, Milwaukee, Wis. There are 14 different types in this new series, covering all welding applications where low hydrogen electrodes are desirable. Each has been thoroughly tested in P&H's laboratory and in their own welding production as well as in the field. The coatings were developed to produce deposits low in hydrogen, thereby eliminating the under bead cracking.

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HELTZEL DUAL DUTY FORMS

Each dual duty form can be used to make two thicknesses of concrete slabs. Illustration above shows same form in upright position for 24" slab and side position for 20" slab. Sizes from 6" up

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These new P&H electrodes are stated to produce excellent welds on problem steels and other alloy steels, including steel castings.

45
Light-Weight Portable Pump

A new light-weight, self-priming portable pump has been announced by McCulloch Motors Corporation, 6101 West Century Blvd., Los Angeles 45, Calif. The pump is rated at 15,000 gal. per hour and is powered by a 5-h.p. gasoline engine similar to the type proved in rugged service on McCulloch

McCulloch Light Weight Pump

chain saws. The centrifugal-type pump has a 28-foot suction lift and is made of cast aluminum. A non-clogging impeller is mounted directly on the engine shaft. The engine has a kick-proof automatic-rewind starter, a rainproof ignition system, and an automatic governor which controls its speed at all loads. Engine controls are conveniently grouped in one panel. There are no special fittings to service as the entire unit is lubricated by means of oil added to the fuel.

46
Converting Pick-up to Dump Truck

A twin-cylinder hydraulic hoist automatically operated from one control knob on the dash, announced recently by Na-

Hoist on Pick-up Truck

tional Truck Equipment Co., Waukesha, Wis., can convert any kind of pick-up into a dump truck without altering the original design of the vehicle.

47
Wrenches Cover Wide Size Range

Two alloy steel, drop-forged adjustable wrenches, stated to embrace larger sizes never before included in this type wrench have been announced by the Owatonna Tool Co., 435 No. Cedar St., Owatonna, Minn. These two wrenches adjust to 29 sizes which normally must be serviced by fixed size, carbon steel wrenches. The smaller wrench, No. OA-24 is 24 in. long, ⅝ in. thick and weighs only 10 lbs. The larger wrench, No. OA-36 is 36 in. long, 1⅛ in. thick and weighs only 22 lbs. The smaller wrench adjusts from 1⅝ in. to 2⅝ in. while the larger wrench adjusts from 2-15/16 in. to 4⅝ in.

48
Camshaft Bearing Set

A new time saving complete set of tools for installing camshaft bearings on International tractors has been announced by the Owatonna Tool Co., 435 No. Cedar St., Owatonna, Minn. The set consists of nine driving collars and one driving handle to cover the complete range of sizes.

49
Special Alloy Steel

A special Alloy Steel, heat treated plate is now produced and offered by the Allied Steel Products, Inc., Cleveland, O. Its special uses are for the repair of construction, quarry and mine equipment. It is claimed to have qualities which offer a maximum resistance to abrasion and impact. Tough and durable, flame cuts with ease and welding versatility. Forms, drills, shears and punches easily. The product is known as Tufalcy wear resisting plate.

50
Moto-Bug Improved

Principal improvements in the 1950 model Moto-Bug, a power wheelbarrow manufactured by the Kwik-Mix Co., Port Washington, Wis., is a large steering wheel to replace the lever bar arrangement formerly used for guiding the unit.

Improved Kwik-Mix Moto-Bug

The steering wheel permits the operator to handle the Moto-Bug in the same manner as an automobile and with the same ease. Steering gear ratio has been increased from 2 to 1 to 4 to 1. Sturdily built, the unit has a rated hopper capacity of 10 cu. ft., or 1200 lb. on the platform body. It is powered by a standard 4 h.p. gasoline engine and travels at speeds of 1½ to 4 mph, both forward and reverse.

51
New Design Features of Gradall

New design refinements incorporated into the Gradall by The Warner & Swasey Co., Cleveland, O., over recent months contribute to improved efficiency of the versatile earthmover. Width of the circular roller path around the circumference of the main turntable has been increased, permitting the use of larger bearing rollers. The hydraulic control valve manifold formerly located at the front of the operator's cab has been moved back adjacent to the pumps at the engine. A 2000-lb. counterweight at the inboard end of the main boom balances the extended portion of the telescoping boom and increases its lifting capacity by permitting more of the power input to act directly on the payload. Elevating cylinders, formerly located below the inner end of the boom, have been moved forward so that they act at a point just ahead of the trunnions. Here a straight thrust with a minimum of pivoting is possible. The boom extension now rides on five rollers. A concave roller has been retained at the top, but two flat rollers split the bearing load at each of the base positions. All cylinders have been redesigned for longer life and simplified maintenance. The Gradall is now offered with a diesel power unit as optional alternate to a gasoline engine.

52
Ball Bearing Power Transmission Unit

Designed primarily for light duty, slow speed anti-friction bearing applications, the Flangette has been developed by The Fafnir Bearing Co., New Britain, Conn. It is described as a simple arrangement of two pressed steel stampings to form an inexpensive flanged housing enclosing

Fafnir Flangette

a standard Fafnir self-aligning Wide Inner Ring type ball bearing. Light weight, low cost, factory sealed-in lubrication and ease of installation are listed as advantages of this complete ball bearing power transmission unit. The Flangette is available for shafts of 18 sizes ranging from ½ in. to 2-3/16 in.

53
Industrial Hydraulic Pump

A new series of rotary gear hydraulic pumps announced by Lear, Inc., Romec Division, Elyria, O., is designed to meet specific flow and pressure requirements of tractors, trucks and construction tools, and is applicable to other heavy-duty hydraulic applications. Model RG-7380, illustrated, is intended for direct drive

(*Continued on page* 111)

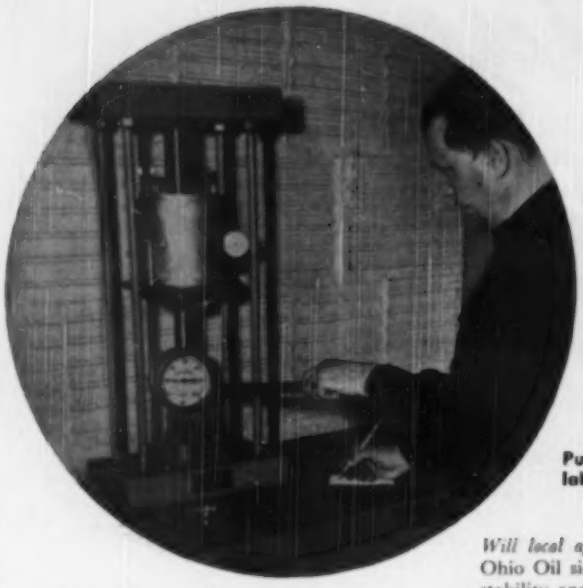
Model RG-7380 Rotary Gear Hydraulic Pump

Bituminous ROADS AND STREETS

MARCH, 1950

Published by Gillette Publishing Company
[illegible] West Illinois Street, Chicago 10, Illinois

Blade mix in progress on a county highway near El Centro, in Imperial County, California



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Will local aggregate make a satisfactory base course material? An Ohio Oil sieve analysis, scientific plasticity and density tests, stability and swell tests will tell you. *What about subgrade soil? How thick must the aggregate base and asphalt wearing surfaces be?* Hydrometer analysis of soil, plasticity, absorption and swell tests will produce the answers. *Whatever your problems in construction or maintenance,* Ohio Oil welcomes an opportunity to find the answers for you. Write, wire or phone, today.

How thick a base and wearing course are needed above the compacted subgrade? Soaked soil briquette is tested in a California Bearing Ratio Stability Machine to determine the answer.

A 2-inch asphalt mix briquette is weighed in water to determine its specific gravity and make a voids-ratio analysis.

This 13-state area is served by Ohio Oil —a major source of asphalt for 25 years

What will spring thaws do to the paving? To help answer that question, this test measures the swell of a test briquette of subsoil, after 4 days in a water bath.

The OHIO OIL Company · ***Asphalt Department***

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MARATHON

★ Here's McGillivray's asphalt plant layout. Crushing plant outlet conveyor glimpsed in right background. Crushing plant not visible. Note delivery tank truck-and-trailer unit going in and an empty coming out via log bridge

Seven Management Factors

Helped This Contractor Avoid a Winter Carry Over

How McGillivray Construction Co. achieved efficient handling of resurfacing project on US 99 in northern California

Roads and Streets Staff Report

ONE of the most interesting examples of good job management coming to the ROADS AND STREETS editor's attention recently, is the performance of McGillivray Construction Co. on US 99 in northern California.

This contractor, with headquarters in Sacramento, had a 35-mile contract section extending northerly along the Sacramento River Canyon from Crespo (near the head of Shasta Dam Reservoir) to a point near Mt. Shasta in Siskiyou County. Contract was awarded May 25, 1949. The bid of $425,000 principally covered new granular base, plant mixed surfacing, and shouldering.

Time Saving Factors

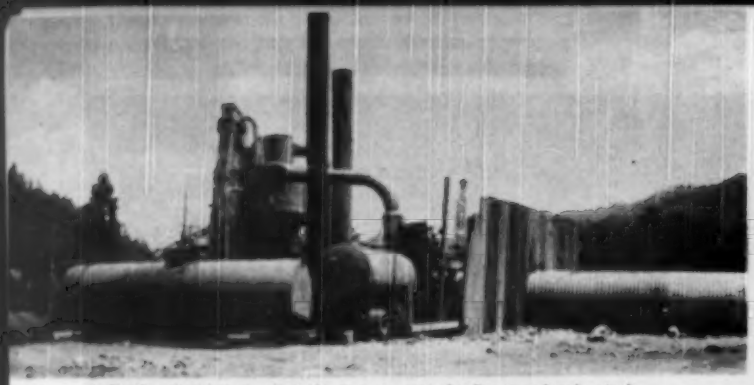
Seven factors, among others, enabled this contractor to maintain an average production for the job of base and surface of 110 tons per hour, despite a 23-mile maximum haul and unusually troublesome problems of traffic maintenance.

1. First factor in the high production was the use of an up-to-date plant, together with hauling and spreading equipment of ample capacity.

The contractor located a gravel flat on the east side of the Sacramento River, approximately in the center of the work, and started move-in of plants and equipment on June 15. No established crossing of the river was available and it was necessary to construct a temporary 60-ft. log bridge to the plant site. The crushing plant set-up consisted of a 24 x 36 Diamond jaw crusher as a primary and a Universal portable crushing and screening plant involving a 20 x 36 jaw crusher, a set of 24 x 42 twin rolls and a 4' x 12' two and a half-deck screen. Power source consisted of one Caterpillar D13000 unit and a set of twin GMC diesels.

The asphalt plant was a Standard Steel Corporation unit built 3000-lb. capacity plant. This is the crane erected design of plant and was readily transported to and erected at the site. Cement treated base, as well as hot mix, were run with the same equipment without plant changes. A capacity averaging well over 100 tons per

★ Out on the job. Contractor's "fewer and bigger" hot-mix trucks expedited placement, helped prevent traffic "snafu"



★ The Standard hot-mix plant, showing aggregate loading tunnel under stockpile site; wood fence used to confine stockpile during peak storage

hour on a hot mix was maintained on a day in day out basis by the plant. Power source for the mixing plant was twin GMC diesel unit.

Crushed mineral aggregate was stockpiled over a 60-ft.-long corrugated metal tunnel (90-in. diameter) and fed through openings and chutes therein to a 24-in. conveyor extending the length of the tunnel to the cold end of the dryer. Mineral aggregate for cement treated base was 1½-in. minus and for plant-mix surface, ⅜-in. minus. Cement content for the base was 2%, and asphalt content for the surface averaged 4.5%.

Superintendent's Eye View of a Job Well Done

By H. L. Morisette

General Superintendent McGillivray Construction Co., General Contractors, Sacramento, Calif.

I believe the accompanying article adequately covers the subject. It is difficult at times to explain how coordination is achieved and maintained. It is just one of those things!

The job was simply organized for sustained operation and every possible foreseeable lag was eliminated in advance. For example, the mixing plant was scheduled to kick off at 4 a.m. To accomplish this, an operating engineer was on the job at 3:30 a.m. and by 4 a.m. had every power unit running and warmed up, the dryer turning over, etc., so that when the operating crew reported at 4 a.m., production STARTED, and generally at 4:05 or thereabouts a load was passing over the scale and on its way to the street. More or less the same pattern was followed for street equipment. Night inspection, servicing, and maintenance of plants and equipment was accomplished daily.

An expeditor maintained a constant inventory of contract materials and parts and scheduled an even flow of supplies, fuel oil, asphalt, cement, etc.

Truck dispatching, as such, was not resorted to. Rather, trucks were scheduled and called 8 hours prior to each shift. The number of trucks was determined by the length of haul and grades encountered as shown on a chart upon which daily progress and production were also plotted. Trucks were rented for the street haul; company trucks were used in the pit.

Shift superintendents were fully and adequately advised prior to "going on", of the previous shifts progress and developments. This was often in the form of a typed memo and included instructions for after-shift moves, special details, and servicing.

About a quarter of the key operators were long-time employees of the company, but it was necessary to break in and indoctrinate, for two-shift work, most of the personnel employed on the job.

While it is true that an unbelievably long stretch of highway was paved in a very short time, there were nevertheless many embarrassing and trying moments when the cement elevator didn't elevate, pumps didn't pump, and rollers refused to roll, at which time aspirin was in heavy demand. The hardest shift was from 3:30 a.m. to 9 p.m., and after.

Two Shifts Used

2. Second was the decision to use two shifts. The set-up was completed in early July and paving operations started July 12. Due to the short working season (generally not extending later than Oct. 15), it seemed imperative to organize the job on a two-shift basis. Each shift was 7 hours.

3. Third speed factor was the close and skillful management attention to material delivery. Mixed material was hauled to point of placement by 3-axle trucks (10 wheelers) carrying an average load of 12.5 tons. All equipment carried lights for night operation. As explained by California district engineer F. W. Haselwood at Redding, about 25 miles of the project was located in the Sacramento River Canyon, involving crooked alignment and almost continuous grades up or down. Through traffic was about 2,800 vehicles daily, of which about 16% was trucks with the volume swelling to about 5,000 near the town of Dunsmuir and Mt. Shasta City. The hauling of over 90,000 tons of base and surface through this traffic over a road with restricted horizontal and vertical sight distance was "quite an accomplishment," in the words of Mr. Haselwood.

The maximum haul from plant to job was about 23 miles, all of it through the canyon section. The contractor so conducted his work that the long haul in both directions was done first, thereafter balanced off in equal sections and the number of trucks reduced systematically. Traffic was controlled past the spreading equipment but the hauling equipment had to move through it. The remarkable feature reported by resident engineer Phil Duffy was that neither the plant nor the spreader had to wait for trucks and there was very little time lost by trucks waiting to load or unload. This is one of the accomplishments of management that resulted in the high average production of base and surface, noted the engineers.

Daily requirements of about 100 tons of liquid asphalt entailed a 274-mile haul from substation storage; 20-24 ton tank trailers were used.

Night Paving Through Town

4. Decision to pave the section through the community of Dunsmuir after 4 P.M. saved delay and minimized traffic interference. Dunsmuir's business district is located along the main highway. Paving operations were started at the northerly limits of the town and proceeded southerly, reached the main business district about midnight, and the outskirts by

(*Continued on page 90*)

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US 90, EAST

Widening and resurfacing project 12.8 miles in length involved unusual 4-course hot-mix construction as solution to extremely severe traffic, soil and moisture conditions. Notes on two other US 90 projects included

By R. E. Killmer
District Engineer, Texas Highway Department, Beaumont

★ Barber-Greene hot-mix plant employed on the "Jefferson County line West" project

★ View of prepared subgrade, ready for first hot-mix widening layer

★ First course of widening strip, hot-mix materials being placed by means of an All Purpose spreader

★ Additional views of first widening lift during and after rolling. Note how old pavement had settled into the wet, black soil cross-section

At the close of the War, the Texas highway department was faced with rehabilitating badly deteriorated pavement on U.S. 90 in Liberty County. The existing concrete pavement, built in 1926, was of the Bates type, 9"-6"-9" by 18 ft. wide. When built, it was probably adequate for the traffic, but just prior to and during the War it was subjected to severe traffic conditions and began rapidly to deteriorate. The subgrade is a highly plastic clay soil with a Liquid Limit as high as 95 with a Plasticity Index of 45 to 60. As might be expected, this subgrade, when wet, has a very low bearing capacity and it was nearly always wet. Rainfall here averages 55 in. per year, with an occasional 80 in. The 1947 traffic count as recorded by the Planning Survey was 3,800 vehicles per day, including many heavily loaded trucks.

Damage Found Severe

It was estimated that if the pavement was repaired by patching, at least 20% would need replacement. Pumping was severe and many small sections were entirely loose and rocking under traffic. In some places, maintenance forces filled in low areas with asphaltic concrete. When rehabilitation work was started, some of this asphaltic concrete was removed and sections of pavement slab were found to be pushed as much as 14 in. down into the subgrade, with five or six layers of patches built on top. Even under these severe conditions, the old pavement did manage to carry this traffic. However, maintenance costs

From a paper presented at an Asphalt Conference held at Fort Worth, Texas, Oct. 31, 1949.

TEXAS CASE STUDY IN ROADWAY MODERNIZATION

were heavy and required the constant attention of a sizable maintenance crew.

The worst sections extended from the Jefferson County line west 12.8 miles, to a point about one mile east of Raywood; and from Dayton 7.4 miles west to the Harris County line, the latter being the first section repaired. This paper will deal more particularly with the "Jefferson County line West" project, but will also include certain details of the "Dayton West" job, as well as a project on a section in Jefferson County extending from Fourth Street in Beaumont to Amelia, 4.4 miles.

A project was set up to rehabilitate the "Jefferson County line West" section late in 1946, for which several methods were considered:

(1) Follow the plan previously used on the Dayton West job; namely, that of breaking out badly deteriorated p.c. concrete pavement, patching with p.c. concrete, widening with p.c. concrete on one side, and placing 4-in. thickness of as haltic concrete full width. The purpose of the asphaltic concrete was to level up as well as strengthen the old pavement.

(2) Build a flexible base of sand-shell over the old pavement and top off with about 2 in. thickness of asphaltic concrete. Widening would consist of a thickened sand-shell base on each side.

(3) Build the so-called "half sole" portland cement concrete pavement. As is well known, this provides for a new concrete pavement directly over the old concrete. Widening was to be taken care of by thickened concrete slabs on each side.

The Plan Adopted

(4) A fourth plan was to widen by building a thickened base of asphaltic concrete on each side, then top off with 5-in. of asphaltic concrete over the entire width, placed directly on the old concrete pavement as it was found without any reconditioning.

In all these schemes, the ultimate pavement width was to be 24 ft.

In making a selection, consideration had to be given, in addition to cost, to a design that would result in least traffic interference during construction. Since detours were out of the question and shoulders were too soft to carry traffic, it was necessary that all traffic be handled through the job at all times and with a minimum of interference. Because of this and because of the fact that the cost compared favorably with other designs considered, it was decided to use the plan last named. By using this design, it was thought that traffic would not be greatly interfered with. This proved to be the case and so far as is known there was not a single written complaint registered by the traveling public.

The typical cross-section of the design adopted provided for widening with asphaltic concrete on each side of the existing pavement, each strip being about 4½ ft. wide at the bottom, sloping to 3½ ft. width at the top and averaging 11½ in. thickness. For the widening, a coarse graded material was to be used (Texas Type A). Material was to be placed in 2½-in. layers compacted thickness. Over both the widening strips and the old concrete there was placed a 5-in. thickness of asphaltic concrete. This thickness was to supply leveling as well as strengthen and reinforce the old pavement.

Minimum Slab Conditioning

The only reconditioning work proposed on the old pavement was to underseal selected sections and remove some old asphaltic concrete patches placed by the maintenance forces. These appeared too fat and soft, showing some signs of pushing under traffic.

The resurfase was to be built up of four layers: 125 lb. per sq. yd. of Texas Type E, a fine graded sheet asphalt; two layers of a Type C material, a coarse graded surface course material estimated at 300 lb. per sq. yd.; and a 75-lb. Type F fine graded non-skid surface course. The plans also included 10" x 8" select material shoulders.

A contract was awarded to Reynolds & Williams, contractors, on April 24, 1947. Construction began May 22, 1947, and the project was completed on May 26, 1948. 147 working days were charged to the contractor out of 368 calendar days; 111 days were lost because of rain or "too wet to work."

Undersealing of selected sections of old pavement was decided on for a two-fold purpose—to fill voids and thereby stop pumping through cracks and joints; and, to stabilize pavement slabs and stop any movement, rocking or otherwise. Each individual section of old pavement was to be given firm bearing on the subgrade.

First work undertaken, therefore, was this undersealing. Originally, it was expected that probably not more than one-half the length of the project would need undersealing, but final developments indicated that nearly all of the old pavement would require it. As a result, there was an overrun of about 52% in this item. The total amount of underseal used was 468,602 gal. of OA-30* asphalt.

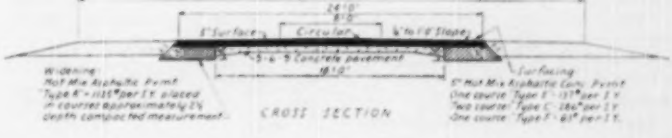
The only other work done on the old pavement was to remove all old asphaltic concrete patches that were too fat or showed signs of shoving. Due to the heavy traffic, it was thought impractical to attempt any breaking out and patching of old pavement; and, too, the old pavement was so badly broken up that it would be difficult to determine where patching should begin and end, short of new pavement throughout.

Contractor's Procedure

Following the undersealing, the contractor undertook the widening work. The existing shoulder was first cut back and rough graded with an ordinary heavy-duty maintainer. A special type subgrade planer (contractor built—see photo) fine graded for the widening, followed as closely as possible with the first layer of asphaltic concrete. Succeeding layers were placed until the widened section had been brought to existing pavement level.

At this point, it might be of interest to explain a situation which developed with respect to some failures in the

*OA-30 is Texas Highway Dept. designation for the 145°F melting point asphalt used for underscaling.



★ Cross-section of US 90 widening and resurface, "Jefferson County line West" project

★ Special contractor-designed subgrade planer used by Reynolds & Williams, contractor. (Texas contractors during past five years have devised and used numerous widening machines, similar to one shown.) (Editor)

newly widened sections. The failures, which were not too numerous, followed an unusually wet rainy spell. The trouble was brought about by water percolating through the numerous cracks of the old concrete to the subgrade and draining to the side; there, being trapped against the widening, the water softened the subgrade, causing the failures. To alleviate this situation, it was decided to place a thin layer of asphaltic concrete material sufficient to seal the cracks. This was done as soon as the weather would permit and as rapidly as possible, in order to seal the pavement before the next wet spell. Some wet weather followed this sealing work but no further failures developed.

Placed Half-Width

After widening operations were completed, succeeding layers of asphaltic concrete on the widened sections were placed in half-widths. There was very little traffic interference during either the widening or the regular spreading operations. Only short sections of road were limited to one-way traffic and generally on not more than two points on the entire 13 miles at any one time. One-way traffic sections were generally limited to no more than 1,000 ft.

A short description of the mix specifications may be of interest. A detailed description of Type A, C, E and F mixes is given in Texas highway department specifications, "Special Item Hot Mix Asphaltic Concrete Pavement" (Stencil No. 8-46-2994).

Type A is a coarse graded binder course with a maximum grading of 2¼ in. Asphalt content of the mix design adopted was 3.4% by weight.

Type C is a coarse graded surface course material, graded 1 in. downward. Asphalt content of design adopted 5.2% by weight.

Type E is a sheet asphalt surface course with a fine graded material grading from ¼ in. down. Asphalt content of adopted mix was 7.3% by weight.

Type F is a non-skid surface course with a maximum grading of ⅜ in. Asphalt content was 4.5% by weight.

The Hveem stability tests on these various mixes averaged 45 except for Type E which averaged about 30. OA-90* asphalt was used in all mixes. A very light tack coat of RC-2 asphalt, about .02 gal. per sq. yd., was applied ahead of the placement of any course except the several courses on the Type A widening material.

Other Project Discussed

To this point, the discussion has been confined chiefly to the 12.8-mile project from the Jefferson County Line Westward. It might be of interest to discuss certain features of the earlier "Dayton West" project.** The main points of difference are that on the latter-named job all widening was done with concrete, and wire mesh reinforcement was used between courses of the asphaltic concrete. This job was completed six or seven months before starting the "Jefferson County West." Hence, experience gained was put to good use. The old concrete was in about the same condition on both jobs. The 7.4 mile section from Dayton West was widened to 24 ft. by placing a 6-ft. concrete strip on one side. Badly broken sections were removed and patched with concrete. Patching was estimated on a crack survey, but increased failures during construction caused an overrun of about 55% in this item. During patching operations, traffic was carried on one lane around break-outs and completed patches undergoing curing. Concentration of traffic in a single lane accelerated pavement failures in the open lane. In addition to pavement damage caused by this concentration, one-way traffic was of considerable inconvenience, and the broken-out sections created a definite hazard. The shoulders were generally too narrow and soft and sometimes too low to accommodate traffic. As a consequence, many complaints were registered by the traveling public. After the completion of the pavement widening and patching, a 4-in. hot-mix asphaltic concrete resurface was placed in three courses. This was for the dual purpose of leveling up and strengthening the old pavement. Paving was placed in half-widths, traffic being carried on the opposite side.

Wire Mesh Tried

The second difference between the two projects may be of particular interest. That is the use on the Dayton West job of welded wire mesh reinforcement between the asphaltic concrete courses. Placement of this mesh was a departure from the usual practice and was the first such used in this district except a short experimental section tried by T. J. Kelly on Highway U.S. 69 in Jefferson County.

Fabricated in 16-ft. long sheets the mesh consisted of No. 9 wire spaced 6 in. longitudinally and 12 in. transversely and electrically welded. The wire was placed in a 1-in. thickness of Type E. asphaltic concrete, followed by two courses of asphaltic concrete, each about 1½ in. thick (types C and D respectively).

During first efforts to pass over the mesh, the wire became entangled in the finisher and it became necessary to improvise some means of holding the wire down. This was accomplished by means of three steel plates or sleds, placed between and outside the finisher's tracks. The sleds consisted of heavy steel plates suspended at the front of the machine and extending back almost to the screw conveyor, with the back ends free to slide over the wire and hold it down just ahead of the asphaltic mix.

After placement of the first course material, raveling spots began to show up during a cold, rainy spell. This raveling was believed to result from a combination of things. It was noted that many of the spots occurred over the loose wire ends where the sheets were lapped, and generally they occurred more frequently where the

*OA-90 is Texas Highway Dept. designation for 85-100 Penetration Asphalt Cement.
**See article, "Mesh-Reinforced Hot-Mix Tried on Texas Overlay," Roads and Streets, December, 1946, for a brief staff article on this project.

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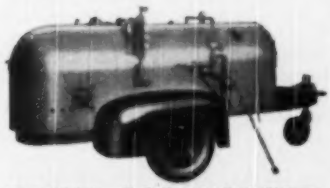

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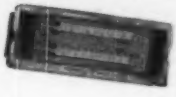

Write on Your Business Letterhead . . . For the Bituminous-Mix Calculator — a ready reference slide rule showing weight of mix needed in lbs. and tons based on area and depth of area to be covered.

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cover material was thinnest. Of necessity, the courses of asphaltic concrete could not be placed in uniform thickness because of the leveling required. It is also believed that some raveling occurred at spots where the asphaltic concrete developed segregation when the finisher thrust the material against weld points. Raveled spots were patched before placing the next course. It was noted that after raveling was patched, further raveling ceased and very few additional spots appeared before placement of the last course.

Mesh Again Tried

Coming back to the Jefferson County line West job, it was decided to place a 5,000-ft. section again using mesh, as a further check on the use of wire mesh reinforcement in asphaltic concrete pavement. The old pavement was very badly broken up and the sections adjacent at each end of the selected section were in about the same condition. It was thought that under these circumstances very decided comparisons could be made that would definitely indicate whether or not the use of wire mesh was beneficial. The wire fabric selected was 6"x6" #10 wire instead of the 6"x12" #9 wire previously used. It was laid under similar conditions; however, no difficulties of raveling were encountered.

The pavement in which wire mesh reinforcement was first used was placed in Autumn of 1946; the second in December, 1947.

As of this date, judging from the condition of these two sections, it can be said that the use of wire mesh reinforcement in asphaltic concrete pavements is beneficial to the pavement and it appears to be both practical and economical. Question might be raised as to whether it is more desirable to apply the cost of reinforcement to additional thickness of asphaltic concrete. The answer would seem to be "yes" if the proposed pavement thickness is 2 in. or less. If the proposed thickness is more than 2 in. (depending on condition of old pavement) it probably would be better to use the wire fabric.

Cracking is decidedly less where the wire fabric has been used, than where it has not. This is particularly evident in the 5,000-ft. experimental section where the contrast in cracking is quite noticeable. On this section, maintenance forces have sealed any cracks by pouring them with a light grade of asphalt. As one drives down the road, the cracks are thus made quite evident. As one passes from the "no wire" to the "wire" section, a decided decrease in number of cracks is noticeable.

Where cracks develop, they seem to open less widely where wire is used. This reduces raveling. Also, the cracks tend to seal over from the traffic, especially in warm weather. The plain asphaltic concrete surface shows a tendency to ravel and develop holes which were not in evidence in the reinforced sections.

It might be added that additional thickness of asphaltic concrete tends to reduce cracks. This, of course, applies only where placed over an old concrete pavement.

Entirely New Section

During construction from Jefferson County line West it became necessary to relocate a short section of the old road totaling about 1,000 ft. Soil and drainage conditions here are particularly bad, and it was decided to build the new grade embankment entirely of select material. This material was thoroughly compacted by wetting and rolling. Then a 11¼-in. base of Type A asphaltic concrete was placed in 2½-in. courses. This was followed with two 1½-in. Type C courses and the whole topped with 75 lb. of Type F wearing course (total thickness of asphaltic concrete, 15 in.). An average of 18 in. of select material was placed under the asphaltic concrete. Shoulders are of select material. This section of road is now carrying better than 4,000 vehicles per day including many heavily loaded trucks. It has been in use about 1½ years and is in excellent condition. No cracks or settlements have yet developed.

Still another section of Highway US 90 was widened and resurfaced with asphaltic concrete. (Fourth Street in Beaumont to Amelia, 4.4 miles). This road, before widening, consisted of a concrete pavement built in 1931, 20 ft. wide and Bates Type 9"-6"-9" in thickness. At the time of widening, it was in fair condition but showing signs of distress. Many joints were pumping and there was some cracking and breaking up. Subgrade conditions were bad and traffic was very heavy—about 7,640 vehicles per day.

Heavy Overlay Discussed

The pavement was widened to three lanes or 36 ft. by placing an 8-ft. strip on each side. Widening was done with Type A asphaltic concrete placed in 2½-in. courses to a total depth of 10 in., as in Jefferson County line West. The concrete pavement was undersealed and then the whole job topped off with a total thickness of 4 in. of Type E, Type C and Type F materials placed in the order named.

This job was completed in April, 1948, and is today carrying more than 7,800 vehicles per day without signs of settlement or cracking.

Some mention might be made of the

Placing Mesh on the "Dayton West" Project, US 90

★ Placing sheet asphalt over wire mesh, using ordinary finisher

★ Close-up of the center steel plate, attached under spreader to press wire mesh against the pavement in advance of covering with hot-mix

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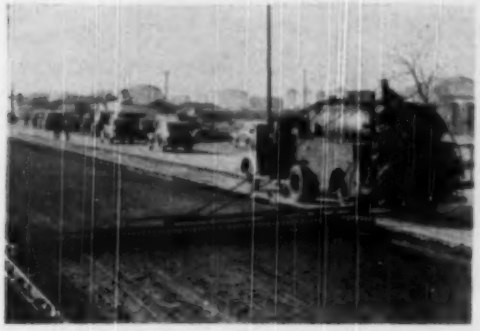
with a new ETNYRE "Black Topper"

Orders for new "Black-Toppers" are coming in fast for delivery in 1950. If you wish to save time, reduce labor costs, avoid money-wasting breakdowns, and handle more types of bituminous work, place your order soon to get delivery when you want it. Get information on Etnyre's new features, prices, and delivery schedule from your Etnyre Dealer or write us.



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"Black-Topper" being used for underseal work to lift pavement by pumping Bituminous Material into weakened base.

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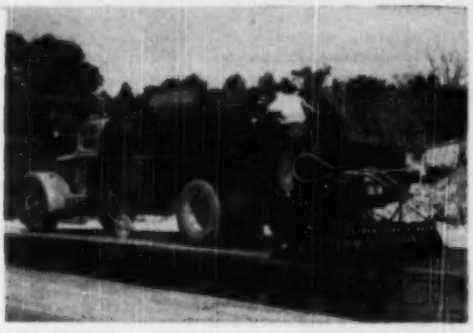

Accurate . . . dependable . . . economical — that's what contractors, engineers and operators all over the world say about Etnyre "Black-Topper" distributors.

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. . . or write, wire, or phone us direct for literature and prices on the new 1950 model Etnyre "Black Toppers." Get latest data on the finest distributing mechanism you can buy—it saves you time, reduces labor costs, stands up under continuous hard usage, is easier to operate, and distributes all types of material accurately.

heavy thickness of asphaltic concrete resurface used on these three projects. This heavy thickness was for the purpose of reinforcing the old pavement as well as leveling it. It is believed by the writer that many of the old concrete pavements in the State that are showing signs of distress under traffic can very definitely be strengthened and reinforced with asphaltic concrete. There seems to be a tendency when asphaltic concrete is used over old concrete to place only a thin course. This is probably satisfactory if it is decided that the old pavement is of sufficient strength to stand the traffic, and the only purpose is to level it. But in most cases, the pavement should have additional reinforcement. A 3 or 4 or 5 in. thickness of asphaltic concrete will satisfactorily do the job.

You no doubt will be interested in the cost per mile of the two projects—Jefferson County line West, widened with asphaltic concrete, and Dayton West, widened portland cement concrete. The first-named 12.8-mile project cost $704,600, including engineering, or $54,800 per mile. The second-named 8.4-mile project cost $393,900 or $48,400 per mile. The work on both projects included placement of 8 ft. selected material shoulders, undersealing, placement of asphaltic concrete, over the widened sections, and the widening of one with asphaltic concrete, the other with portland cement concrete. In comparing these figures, it should be remembered that on one a total of 4 in. of asphaltic concrete was placed over the old concrete pavement while on the other a 5 in. thickness was used. On one, the asphaltic concrete was reinforced with wire fabric while on the other it was not, except on a short experimental section. Both sections are performing very satisfactorily and no particular advantage of one over the other is in evidence except in regard to the value of the wire mat. Both mat sections are carrying better than 4,000 vehicles per day. One was completed nearly three years ago and the other over a year and a half ago.

Acknowledgments

Following are some of the personnel on the projects described:

Dayton West: E. D. Parmer, senior resident engineer, handled the engineering work. Brown & Root were contractors.

Jefferson County Line West: Reynolds & Williams, contractors. E. R. Young, senior resident engineer, handled all engineering during construction. Plans were prepared under direction of Charles L. Davidson, senior resident engineer.

Beaumont to Amelia: Reynolds & Williams, general contractors; Noonan Construction Company, sub-contractors handling the complete job. E. R. Young, senior resident engineer, directed all engineering and inspection work.

On the Reynolds & Williams job west of Jefferson County line a Barber-Greene asphaltic concrete mixing plant was used. It was a three-bin, continuous mixing type plant. Daily production averaged 495 tons for Type A material, 425 tons for Type C, 343 tons for Type E and 356 tons for Type F material.

Triaxial Testing

(Continued from page 52)

tioned data are summarized in the following tabulation for 8, 12, and 16 thousand pound wheel loads, for the three degrees of subgrade compaction, and for the use of crushed stone alone or crushed stone with caliche subbase. From this table it may be noted that from 2½ to 5 in. of depth of base may be saved by compacting the subgrade thoroughly and that 5 to 11½ in. of imported, high grade base material may be replaced by the use of the local caliche subbase.

Assurance from the field forces that construction densities comparable to those obtained in the laboratory by use of the 13.26 ft. lb. per cu. in. compactive effort will be attained and that a light wearing course would be temporarily adequate would lead us to recommend, as a minimum, the use of a 12-in. base consisting of 5 in. of crushed stone and 7 in. of caliche subbase for this section of this highway. These depths are based on the tabular values for a 12,000 lb. wheel load as previously suggested for fairly important highways. Similar analyses were made for other subgrade soils representing other sections of this highway.

SUMMARY

The depth of pavement problem has been generally discussed and a method of classification has been presented for relating disturbed highway base and soil materials to their usefulness in construction. A specific example of selecting depth of flexible base is shown, wherein 3 in. of base material may be saved by compacting the subgrade to a reasonably high density, and where a local caliche subbase material may serve as a substitute for the lower seven inches of expensive base materials. These items represent substantial savings which can be obtained systematically and with confidence.

Part III will cover sampling and testing of undisturbed soil cores and application of triaxial test results to bridge foundations.

Texas Requires Registration of Heavy Machinery

The attorney general of Texas recently ruled on the movement of heavy machinery over the highways. The Texas highway department has interpreted the ruling as follows:

1. Highway building and maintenance machinery when operated between projects or jobs or other movements on the highways, must be registered unless transported on other registered vehicles.

2. Regular building machinery, oilfield equipment, etc. is now required to be registered if operated upon the highways.

3. Highway building and maintenance machinery when used on highway construction projects is exempt from registration only when used in the section or sections of highway under construction and between the construction project warning barricades.

4. Highway building and maintenance machinery such as road maintainers, rollers, sweepers, etc. must be registered if operated on the highway on the way to the place where actual work starts, and not actually performing a construction or maintenance

5. When "Highways" are referred to above, it means all public roads and city streets. This means that machinery and equipment owned by governmental agencies must also be registered and titled.

D. C. Greer, state highway engineer, said that many pieces of highway building, maintenance and construction machinery previously exempt from registration must now be registered and titled.

Clearing House Section Outstanding Used Equipment Values

Over one hundred fifty individual advertisers feature an exceptionally large selection of used equipment in the 10-page "Clearing House" section which starts in this issue on page 116. Readers will find the "Clearing House" a dependable and informative directory of outstanding values in used equipment and we suggest that you make perusal of these pages a regular habit each month. At any time that you have equipment you wish to sell, anywhere in the country, we suggest that you present your offerings in our "Clearing House." This section is growing faster, getting larger every month because it's doing a better, quicker selling job—at one low cost!

WHEN you're ready to resurface old roads or build new ones, take advantage of Tarmac's many valuable properties—properties that result in faster job progress . . . in lower labor costs . . . in durable, long-wearing, smooth-riding road surfaces.

Consider, for example, Tarmac's ability to coat the aggregate rapidly and thoroughly, thus reducing mixing time. Plus its ability to penetrate *right on through* dust or moisture, so that there's no need for highway crews to remain idle while waiting for the "right" weather. Important, too, is the way Tarmac resists the stripping action of water, without the use and the extra cost of additives.

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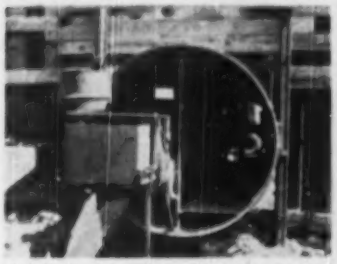
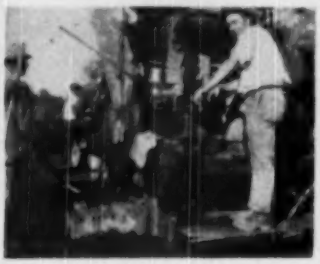
★ After the pavers had passed through Dunsmuir—after nightfall to minimize traffic interference

★ In Sacramento Canyon—curve and grade typical of conditions that hampered material delivery under traffic





★ Left: Feed tunnel seen from the outlet end. Right: Finisher working on the upper lane of a superelevated curve. Note outlet at end of the spreading auger on left and steel template used to form a uniform 2-ft. wide (4%) shoulder taper. Lane width 14 ft.

Seven Management Factors

(*Continued from page 80*)

8 A.M. Operations were carried on continuously for 24 hours during which time 3200 tons were placed.

5. Adoption of an unusual structural feature for this region, namely, cement treatment of crushed rock base, also speeded the job. Cement was added primarily to aid in holding the base intact under the heavy volume of traffic until the plant-mixed wearing course was in place. Structurally the project was unusual in that the base consisted of plant mixed crusher-run material in which was incorporated 2% portland cement.

A high degree of planning and coordination was necessary to insure proper maintenance of the base through the day and night, and yet to have it sufficiently dried to allow prime oil (SC 2) application the following day. The oiled base usually carried traffic for about 10 days before being surfaced, so that the success of the job was largely dependent on the quality of the base course and the promptness and thoroughness of the prime oil operation.

6. Careful advance analysis of the hot-mix spreading and finishing operations was an additional efficient factor. Superintendent H. L. Morisette stated that two spreading and finishing machines were used to provide flexibility of operation and to do away with loss of time involved in moving back to bring up opposite lanes. Generally, the morning shift crewmen would bring up a single lane and at the end of shift would park their machine—then the afternoon shift would start the opposite lane with the second machine and thus complete a full section to the point where the morning shift had parked.

No detours were available and traffic as high as 5000 vehicles per day was piloted through the work.

The contractor's accomplishment on the job was particularly gratifying to the Division of Highways. Had the job not been completed as it was on the third of October, the night shift would have had to be eliminated on account of unsuitable temperatures. Any delay beyond the actual time of finishing carried a threat that the job might not be completed in one season. This would have been very uneconomical for both the contractor and the Division of Highways. On his part, the contractor states that the comprehensive advance analysis and well-prepared plans of the Division of Highways District Office, together with the excellent engineering supervision provided by engineer Phil Duffy, contributed largely to the sustained operation.

7. In a job of this nature, there are many incidental operations not directly contributing to the delivery of base or surface to the road, but upon which sustained progress depends. There was shoulder blading and priming, base repairs, base priming, tack over existing pavement where no base was used, emulsion seal over completed surface and temporary traffic stripe. The contractor was able to carry on all of these operations at the proper time, which accomplishment actually expedited his major operations.

During the period of the job, two days only were lost because of weather and one-day shutdown was made to replace a power unit. The job was completed on October 3.

H. L. Morisette was general superintendent; F. C. Crilly and Tom Cowan, shift superintendents; Wm. Hogg, general plant foreman; S. C. Muir, crushing plant foreman; R. L. Cooper, office manager. Lee Stephens directed and supervised the trucking operation for the Stephens Trucking Co. of Stockton, California.

For the State of California: Phil Duffy was resident engineer; Robert Schultz, chief plant inspector; Joseph Fonseca and Ray Huck, street inspectors. F. W. Haselwood is district engineer and Clyde Amesbury, construction engineer of District II.

McGillivray Job At a Glance

Location: US 99 Crespo to Mt. Shasta, Calif.

Length: 35 miles.

Tonnages: 39,170 tons plant mixed cement treated base (3" to 6" thick). 49,830 tons asphaltic surface (1½" to 3"). 2,400 tons of paving asphalt. 4,600 bbls. cement.

Equipment: 1 Adnun and 2 Barber-Greene finishers; Austin Western & Galion rollers; Caterpillar No. 12 motor graders (see article for plant details).

Best Day: Base construction, 1,680 tons in 14 hours (45 second mixing cycle); surface 2,070 tons in 14 hours (30 second mixing cycle).

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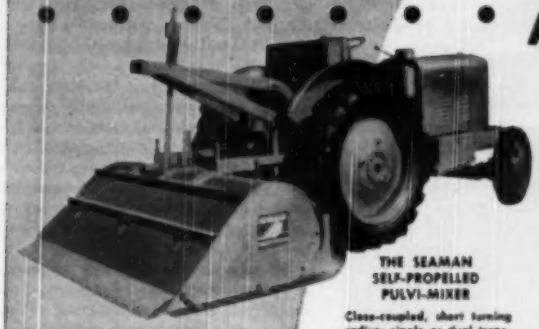

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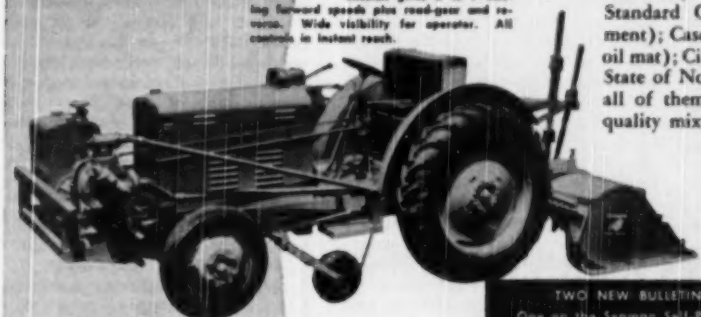
Close-coupled, short turning radius; single or dual transmission gives 3 to 7 mixing forward speeds plus road-gear and reverse. Wide visibility for operator. All controls in instant reach.



THE SEAMAN SELF-PROPELLED TRAV-L-PLANT

All the advantages of Self-Propelled Pulvi-Mixer plus spray bar, pump, pump tachometer and tachometer wheel for accurate, no-migrating, no-evaporating admixture of bitumen or water most efficiently just ahead of rotor. Single or dual transmission, like Self-Propelled Mixer gives mixing speeds to match all conditions.

THE SEAMAN PULL-TYPE PULVI-MIXER

Have selective speed transmission controls rotor-speed to obtain best mixing despite variables in speed of towing tractors. Can easily be equipped with spray bar, pump and tachometer wheel for bitumen or water taken from transfer or tank truck.

Yes, — large *projects* that have been handled by states, municipalities, counties and contractors such as these, — where *all* mixing was SEAMAN-produced: Andrew Scherer, contractor, N. C. (soil-cement); Davis Construction Co., contractor, N. Y. (bituminous); Standard Concrete Pipe Co., Cal. (Soil-cement); Cascade County, Montana (re-claiming oil mat); City of Birmingham, Mich. (asphalt); State of North Carolina . . . check with any or all of them about high production and fine quality mixing by the SEAMAN.

In short, the SEAMAN brings "plant-mix quality at *lowest* road-mix cost."

These new quality-mixing records are due to selective speed transmissions that match mixing speeds exactly to materials.

TWO NEW BULLETINS

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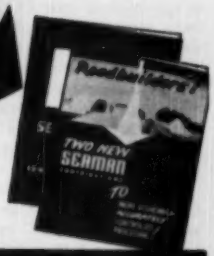

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Asphalt Paving Technologists

Hold Lively Meeting at St. Louis

Annual session marked by criticism of curing-time variations in MC cut-backs now on market. Triaxial testing developments spotlighted. Current methods of interpreting triaxial compression tests on granular mixtures declared inconsistent in paper by Professor Housel of Michigan

THE need to tighten up on MC cut-back asphalt specifications, particularly with respect to factors affecting curing time, was one of the topics at the Association of Asphalt Paving Technologists annual meeting. The Association's business meeting and technical sessions were held Feb. 6 and 7 in St. Louis.

Robert G. Clark, chief chemist, New Mexico state highway department, reviewed the problem in a paper, "Control of Curing Time of MC Cut-Back Asphalts." This paper noted the tremendous increase in the use of cut-back asphalts in highway work during the past 7 or 8 years, with MC-3 being the most popular grade and possibly equaling all other grades combined in volume used in the West. Adoption of uniform specifications in 1939 was a great step forward, and these specifications form the basis for AASHO and ASTM recommended specifications today. In the intervening years, New Mexico has used over 50 million gallons of liquid asphalt road materials, obtained from a wide selection of crude oil and individual refineries.

Little trouble occurred with MC materials purchased under the standard specifications until after the war; apparently producers were adhering to the original intent of the specifications, in their design of curing blends, which was to cut back the base asphalt with kerosene or other agent of similar boiling range. Highway engineers meantime developed experience and skill in laying out their aeration and mixing work for road-mix jobs in the Western States.

More recently producers seem to have experimented with their cutting stock, and the MC products while technically meeting various standard tests have shown less predictable curing time under given conditions.

Mr. Clark's paper presented a correlation of the service behavior of products from ten oil companies. He proposes a new specification for MC liquid asphalts which narrows down the distillation requirements, so as to insure the proper blending materials and provide controlling limits on curing time for each MC grade.

A study of the curing speeds of cut-backs was reviewed in a paper by J. R. Martin, Oklahoma A. & M. College, as part of a paper on this school's highway research program.

Triaxial Testing Notes

Triaxial testing was prominently covered in the program. A paper by W. H. Goetz and C. C. Chen, Purdue University Engineering Experiment Station, reviewed studies in the use of a vacuum technique applied to stability tests for bituminous mixtures. Use of vacuum conditions was said to offer simplification, thereby promoting the use of the triaxial method generally. The vacuum technique is applicable, concluded this paper, because the variables investigated (kind of aggregates, gradation, percent asphalt, penetration of asphalt, density of test specimen, and testing speed) affect the test results in a manner entirely consistent with results from the conventional triaxial test.

Dr. Normal W. McLeod, engineering consultant, Department of Transport, Ottawa, Canada, gave a "slide lecture" review of a paper entitled "A Rational Method of Design for Bituminous Paving Mixtures." This presentation, concerned with measuring the stability of pavement mixtures otherwise adequate, was intended to show how the triaxial test can be used to design pavements on a rational basis, taking all stress influences into account. An all-inclusive formula was developed which embodied coefficients for such factors as lateral shear alongside a tire contact area, and frictional resistance between the pavement surface and base during braking action. His analysis emphasized the value of obtaining a good seal or bond with the base.

A paper by William S. Housel, associate professor of civil engineering and research consultant, University of Michigan, dealt with "some fundamental inconsistencies" in the interpretation of triaxial compression tests on granular mixtures. An analysis of actual test data from research in progress by Civil Aeronautics Administration showed that two different approaches could result in two different values for the Cohesion Shearing Resistance "C" in the Coulomb equation, for the granular mixtures employed.

Mathematical reasoning was presented which leads the author to conclude that the Coulomb equation and the Mohr stress envelope, which is the graphical representation of that equation, violate the basic laws of static equilibrium and therefore cannot be properly applied to the internal stability of granular materials. By the same concept, it was pointed out that an internal friction concept cannot be properly used to represent principal stress relations or internal stability in any material where cohesion is a factor.

In suggesting a complete rejection of the Coulomb equation theory, Professor Housel characterizes this theory as a transitional concept with which others have been dissatisfied. He noted that the validity of using internal friction as the concept of resistance is not questioned where a material having granular characteristics is subjected to direct shear under a confining normal pressure.

It was said that this analysis might

Lettier, Rice and Goetz Receive Honors

At the St. Louis meeting the paper entitled "Mechanism of Absorption of Bituminous Materials by Aggregate," by J. A. Lettier of the Shell Oil Company, Wood River, Ill., was selected by the board of directors as the best paper presented at the Association's 1949 meeting.

The paper entitled "Suitability of Indiana Dune, Lake and Waste Sands for Bituminous Pavements," by J. M. Rice and W. H. Goetz of Purdue University, was awarded honorable mention.

Mr. Lettier's paper was given the Victor Nicholson award established by an anonymous donor in honor of Mr. Nicholson, former Association president, whose death occurred in 1948.

help explain some of the unexplained inconsistencies in triaxial test results. The author praised the work of the CAA laboratory at Indianapolis, as representing a new approach to flexible pavement design showing great promise.

Boundary Stress Reaction

The CAA research noted above was reported in a paper by W. M. Aldous, Chief, Soils and Surfacing Branch, Technical Development, Civil Aeronautics Administration, Indianapolis. Entitled "A Preliminary Report on the Load Transmission Test for Flexible Paving and Base Courses," this paper described the techniques developed for measuring and evaluating stress reactions in the boundary area surrounding applications of punching loads on test sections under laboratory conditions.

Other papers presented at the St. Louis meeting included: "A Discussion of Mixture Proportion Control Using Continuous Mix Plants," by Tom Humphries, Michigan state highway department; "Penetration Macadam Construction in Maine," by E. R. Merrill, Maine state highway commission; "Air Blowing Asphalts with Special Reference to Use of Catalysts" by Dr. A. J. Hoiberg, Lion Oil Company; "Low Temperature Maximum Deformability of Ashpalts," by Dr. E. C. Hughes and R. B. Faris, Jr., Standard Oil Co. (Ohio); "Fundamental Concepts of Asphalt Emulsions," by A. J. Day, Bitucote Products Division; "Statistical Analysis of Immersion-Compression Test Results," by C. Poel, F. Dijkstra and L. W. Nijboer, Koninklijke-Shell Laboratory, Amsterdam, Holland.

Tom W. Holman of Washington Passes

Tom W. Holman, chairman of the Washington state highway advisors commission from 1941 to 1949 and leading figure in western highway administration during that period, died Jan. 15 at age of 64.

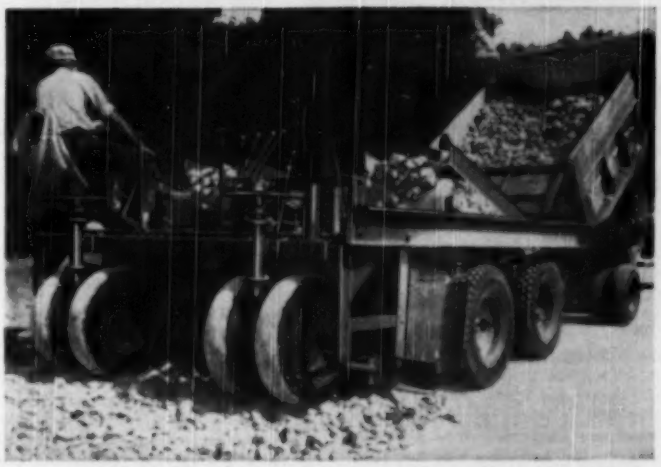
Tom W. Holman

Mr. Holman was trained in law, graduating with an LLB from the University of Illinois and practicing in Chicago and later in Washington state at Port Townsend and Seattle. He was president of the Washington state good roads association in 1938, and again at the time of his death was active in the association's affairs.

New York State Plans $8,700,000 Project

Bid proposals on the largest single project ever to be advanced by the New York State Department of Public Works will be received by Superintendent Bertram D. Tallamy on March 29 for the long awaited Railroad Grade Crossing Elimination Project for the City of Corning. Estimated at $8,707,155, the work will include the elimination of all crossings at grade with the Delaware, Lackawanna and Western Railroad and the Erie Railroad, 6.89 miles of which will be moved. The work is also closely integrated with Corning's Urban Arterial Route program and will be of tremendous importance to the ultimate solution of traffic problems.

it pays off



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★ Applying tar where new gravel has been added to strengthen the roadbed

Practical Questions and Answers on

Tar Treated Gravel Roads

By Geo. E. Martin

Consulting Engineer, Paving Materials Section, The Barrett Division, Allied Chemical & Dye Corp, New York, N.Y.

GRAVEL roads are more widely distributed over the United States than any other improved type. Most states have many miles of this type of construction and practically all have some of this type road. The care of the gravel road, therefore, is practically a universal problem.

Plain gravel roads provide very satisfactory driving surfaces if the traffic is not too heavy. They are dusty, and if vehicles are spaced close together, the dust is very objectionable and sometimes dangerous. It is also very disagreeable for those who live adjacent to the road. The dust covers the vegetation and adds to the cares of the housewife. The material lost from a road 18 ft. wide has been estimated as more than 100 cu. yd. per mile per year. It costs money to replace this material and, in many localities, the supply of good road building gravel is scarce and becoming depleted.

One adequate solution of the problem is to treat the road with tar and thus change it to a bituminous type. This will eliminate the dust and loss of material and add to the useful life of the road by waterproofing the surface.

Design Fundamentals

The gravel used in roads varies widely in different parts of the country and may change in a few miles along a specific highway. In some cases it is processed in a rather elaborate plant and in other locations it is used, without modification, from an existing natural deposit. Generally what is available must be used, but the nearer the following gradation can be approached, the more stable the road will be.

Passing 1 in. sq. sieve	100%
Passing ¾ in. sq. sieve	85–100%
Passing ¼ in. sq. sieve	20–60%
Passing No. 10 sieve	5–30%
Passing No. 200 sieve	0–10%

Certainly the gravel road must be strong enough to support the traffic coming upon it, if the tar treatment is to be successful. There must also be adequate drainage to assure this support at all times of the year. Sometimes a gravel road which has behaved well before treatment will fail, under the same traffic, after treatment. This is caused by the fact that prior to treatment the water moved up through the gravel and evaporated from the surface. After treatment it was sealed in and collected below the tar top. This can be prevented by adequate drainage and a sufficient depth of gravel before the treatment is made. If the gravel road, which is too weak, has been treated and breaks appear, no great harm will be done if not neglected too long. The remedy is to scarify the surface, correct the drainage, add new gravel if necessary, and retreat with tar. As a matter of fact this was standard procedure almost every spring with the early tar treatments.

While judgment plays an important role in tar road work, there is a recommended way to perform every step. How do these suggestions compare with your methods?

A few questions and answers may serve to clarify the problem of obtaining a satisfactory tar treatment of gravel.

1. What gradation of gravel can be treated?

As we have said, better results will be obtained with the gradation already given. However, practically all gradations can be treated although the grade and amount of tar must be modified to meet different gradations.

2. What is the effect of clay and loam in the gravel?

These materials should be kept to a minimum, and in no case should exceed 20% since they seriously reduce the stability of the gravel when present in large amounts.

3. What is the effect of dust laying chlorides?

There is no chemical reaction between the chlorides and tar. However, an excess of chlorides may hold more water in the gravel than is desirable. It is safer not to treat with tar in the same year that chlorides have been applied.

4. What depth of gravel is necessary?

Sufficient to provide strength to support the traffic. This depends upon a number of factors and must be decided on the basis of experience with the particular road.

★ A plain gravel road loses large tonnages of stone per year

★ A tar-treated gravel road saves stone, ends the dust problem

5. What is the minimum width which should be treated?

Eighteen feet. Wider is better. The edge of the treatment is the weakest part and traffic should not be encouraged to drive off and on the edge as may be necessary on a narrow road.

6. How much tar should be used?

The amount and the operations are the same as for the penetration method just discussed except that usually no cover is used on the tar. This is because the tar will be covered immediately with the gravel to be mixed.

7. What is the effect of moisture in the loose gravel?

It also should be damp but not wet.

8. What is the effect of temperature on the results?

The tar will not coat so well in cold weather. Best results are obtained when the air temperature is above 50° F.

9. What grade of tar should be used for mixing?

As heavy as can be satisfactorily handled on the road. Generally this will be from RT-5 to RT-7 although as heavy as RT-9 has been used.

10. How much tar should be used?

That depends upon the gradation of the aggregate. If the grading is on the fine side, there will be more surface area to be covered, and if it is on the coarse side less tar will be needed. Recommended amounts are as follows:

2"	loose depth	0.8 to 1.0 gal. per sq. yd.
2½"	loose depth	1.0 to 1.2 gal. per sq. yd.
3"	loose depth	1.2 to 1.4 gal. per sq. yd.
4"	loose depth	1.5 to 1.7 gal. per sq. yd.

11. What is the maximum amount for each application?

More than one .5 gal. per sq. yd. will usually result in tar running off the side of the road. If it doesn't, the amount can be increased.

12. How should the mixing be done?

Any machine or procedure which will thoroughly coat the gravel with tar is satisfactory. The early work was done with blade graders and graders still have some advantages. They are found almost everywhere. The

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★ Blade mixing is still the most popular method although mechanical mixtures or travel plants are gaining in popularity

★ Spreading cover stone on a seal coat. See text for discussion of principal questions on this important step

gravel is rolled over in front of the glade and the tar scrubbed onto the particles. Various mixing machines have been developed and used.

13. How should the mix be spread?

The mix is usually spread with a blade grader or by the blades attached to the mixing machine.

14. How should the mix be consolidated?

One of the best ways is to use a pneumatic tired roller. The rubber tires of the heavy mixing and spreading equipment will also assist in the consolidation. A flat wheel roller is generally used to give the final finish.

15. When can traffic be permitted on the road?

As soon as the mixing and spreading operations have been completed. Traffic will assist in the consolidation.

16. Should the mix be sealed?

Yes, before it goes into the winter. The same procedure described under the surface treatment method may be used.

Maintenance Suggestions

Gravel treatments should be watched closely during the first year. Holes and weak spots should be repaired immediately.

Additional surface treatment will be required from time to time.

Surface Treatment

An all weather road carrying a surprising amount of traffic satisfactorily and economically can be obtained by the use of tar-treated gravel.

There are two general methods of treating gravel roads with tar. In one method a surface treatment is used and the tar penetrates into the road surface while in the other method the tar and gravel are mixed together by means of road machine. The mixing job has even been done in a central mixing plant, although it is probably not correct to call the result a gravel treatment.

1. What is the effect of gradation?

Gradation is of less importance in this method. Large sizes are not objectionable.

2. What should be the condition of the surface of an existing gravel road?

It should be reasonably well consolidated and smooth enough to be easy riding. Working with a blade grader may be necessary to obtain the smooth riding surface. Sweeping is rarely necessary unless there is a layer of very fine, dusty material on the surface. If the road is new it will probably be necessary to consolidate the surface by rolling.

3. What is the effect of moisture on the tar treatment?

Dampness in the road will assist the penetration of the tar. Free water will prevent adequate penetration. When the tar is applied the road should be damp but not wet. When the road is very dry a sprinkler may be run ahead of the tar distributor to provide a damp surface. A rain on the tar after application will usually do no harm.

4. What is the effect of air temperature?

The tar will not penetrate so well in cold weather. Best results are obtained when the air temperature is above 50° F.

5. What grade of tar should be used?

RT-2 to RT-4. The lighter grade when the road surface is tightly closed and the heavier grade when the road surface is open. All of the early work—prior to about 1924—was done with tar corresponding to RT-2.

6. How much tar should be used?

As much as the road will absorb. Generally from .25 to .5 gals. per sq. yd. New gravel may take .75 gal. or more.

7. Should the tar be covered?

A light covering of sand is quite commonly used. Sometimes this sand is dragged with a sled drag to take up any excess tar.

8. Should the road be rolled?

Generally it is not necessary. Traffic will furnish adequate consolidation.

9. When can the road be opened to traffic?

As soon as it is covered.

10. Is a seal coat necessary?

Yes. The seal coat is needed to produce a better traffic and weather resisting surface.

11. When?

Preferably after the road has been subjected to traffic for some weeks. It is common practice to seal all of the new treatments just before they go into the winter.

12. What grade of tar should be used?

While the same grade used in the original treatment may be used, a heavier grade will produce better results.

13. Should the seal coat be covered?

Yes. For the lighter tars use sand, and for the heavier grades use stone or slag chips or pea gravel.

14. Should the cover be dragged?

It is an advantage with sand. For the larger aggregates best results will be obtained with a broom drag.

15. Should the cover be rolled?

It is not necessary with sand but is advantageous with the larger aggregates.

Road Mix Method

1. What is the effect of gradation?

Good gradation is quite important. Large pebbles will be pulled to the top during the mixing operations. On the other hand there should be sufficient sand present to fill the voids in the larger stone. This will generally be about 40%.

2. What thickness of gravel should be mixed and coated with tar?

This depends upon several factors such as climatic condition, traffic, etc. Usually the thickness will run from 2 to 4 in. of loose gravel.

3. How should an old gravel road be prepared?

If all new gravel is to be used the old road need only be shaped with a

blade grader. If part or none of the gravel is to be new, the road surface should be scarified to provide the required thickness of loose gravel.

4. Should a prime or tack coat be used?

It is worth the money. If all new gravel is to be used the prime or tack coat may be applied to the existing road surface and the new gravel spread over it. If the surface is scarified the loose gravel may be moved to one side and the exposed surface given the prime or tack coat.

5. What grade of tar should be used?

Preferably a light grade, such as RT-2 or RT-3. However, it may be more convenient to use the same grade as used in the gravel mix and good results will be obtained.

Safety Record at Allatoona Dam

National Constructors, Inc., contractor on Allatoona Dam, a $32,000,000 hydro-electric power dam in Georgia, reported a low job accident rate. This project, under way since 1946, is now nearly completed.

This company has consistently maintained an excellent accident prevention record in the three years which this project has been under construction, as follows:

Year	Man Hours	L.T. Injuries	Days Lost	Freq. Rate	Severity Rate
1946	275,311	8	260	26.65	.94
1947	777,676	6	250	7.72	.33
1948	1,191,867	7	164	5.87	.14
1949	485,653	3	120	6.18	.25
Total or ave.	2,732,527	24	800	8.78	.29

There were no fatal or permanent disability injuries to the above date—1949 report.

This project is being constructed under supervision of the Corps of Engineers under the jurisdiction of Col. W. K. Wilson, Jr., District Engineer, Mobile, Alabama District. K. L. Parker is Project Manager for National Constructors, and Charles A. Jackson is the government Resident Engineer. Safety engineering supervision has been provided by William H. Duncan and William I. Sullivan.

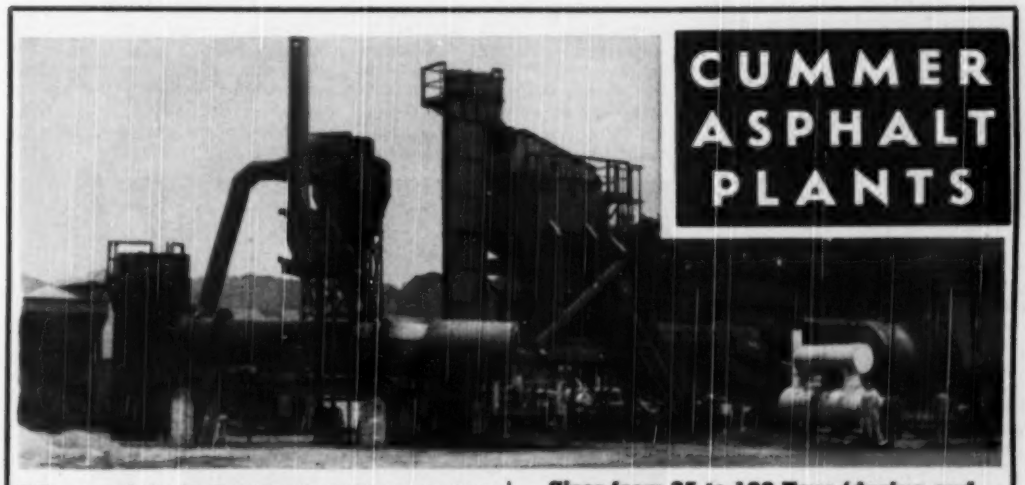
AGC of West Virginia

Ray E. Ritchie of Boso & Ritchie, highway and heavy contractors, of Ravenswood, W. Va., was elected president of the Associated General Contractors of West Virginia, succeeding H. W. Schnider of Parkersburgh.

"Leadership in Management" Program in N. J. Highway Department

Using the supervisory personnel of the maintenance division as a "pilot" group, New Jersey's state highway commissioner Spencer Miller, Jr., has launched a Leadership in Management movement in the department. The details of the program were outlined at a staff meeting.

The program consists of sending each of the maintenance supervisors a series of 52 subjects dealing with leadership. These subjects, each in attractive folder form, will be sent out at the rate of one a week for a period of one year. They deal with the art of getting along with people, the importance of respecting other people's ideas and opinions, loyalty and cheerfulness, to name but a few of the subjects. In addition to the folder, a form is sent to each supervisor by which he is enabled to submit suggestions for departmental improvements.



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Common Sense Suggestions On Local Road Blacktopping

A letter from Professor Ben H. Petty of Purdue University to a county road commissioner

Dear Mr. Blank:

Your letter of August 9th typifies the confusion in many county highway departments resulting from the vigorous advocacy of various materials, mixes, machinery, and methods by representatives of various interests in the so-called "blacktop" field. I am too old in the game to stick my neck out in hair-splitting controversies, but I'll gladly state a few fundamental principles based on my own personal opinions and not as an official representative of Purdue University.

1. In general, we get about what we pay for in highway work, assuming of course that specifications are adequate, bids are reasonable, materials are of good quality, and inspection is high class. For instance, "blacktop" surfaces range all the way from a cheap dust-layer, through the intermediate seal coats, surface treatments, road-mixes, etc., up to the high-type bituminous concrete, sheet asphalt and rock asphalt surfaces.

2. Selection of types should be based on several factors, such as: importance of the road, condition of base, adequacy of alignment, availability of suitable local materials, present and anticipated amount and type of traffic in near future, funds available, engineering and inspection personnel in charge, etc.

3. No county road should be blacktopped in less than 50 feet of right of way. Get the needed right of way first, or you will never get it! Don't pay a thin dime for needed right of way except where relocations are made. Property hasn't paid a cent for construction and maintenance of roads in Indiana since 1932. The motorists pay the bill in gasoline tax and license fees. We should not ask the motorists to pay for a 1949 road surface in a horse and buggy right of way. If the landowners along a road want a stabilized, dustless surface, they should give the extra five to ten feet of right of way required, involving, usually, the good-riddance of a fence-row of bushes and briars. What little they pay in gas tax and license fees isn't a drop in the bucket to the total cost, which is paid mostly by city motorists.

4. A road is no better than its base and drainage! Barrels of money have been wasted in this and other states by placing blacktop surfaces on gravel or stone bases of only three to five inches thickness and with little or no drainage provisions. *Get the road ready first!* Start a year before blacktopping to get the fences back, build up the base to *at least* eight inches of compacted aggregate, shape the surface for smoothness and crown, remove the high shoulders and open up adequate side drainage ditches. Only then are you ready to consider blacktopping.

5. There is a definite trend away from mixed-in-place to plant-mix methods of bituminous surfacing. The latter facilitates greater uniformity in aggregate gradation and in the proportioning of aggregate and bitumen. Some 13 years ago, a large number of samples were taken from mixed-in-place surfaces on state roads in various sections of this state by the Joint Highway Research Project at Purdue. These were analyzed in the laboratory and the proportion of bitumen to aggregate varied approximately from 2 to 12 %. This illustrates the difficulty of obtaining uniformity of mix. I have seen some very good mixed-in-place jobs, and I have seen some very sad ones.

6. The responsible officials must decide whether it is best in the long run to build a limited mileage each year of the higher type, plant-mix surfaces, or a much greater mileage of the mixed-in-place type requiring much more frequent, expensive patching and surface treating.

7. Uniformity and density of mix are important. Density is a barrier to water which is detrimental to most any road.

8. Good specifications and good inspection will pay big dividends.

Wishing you luck in solving these problems, I am, Cordially yours—*Ben H. Petty.*

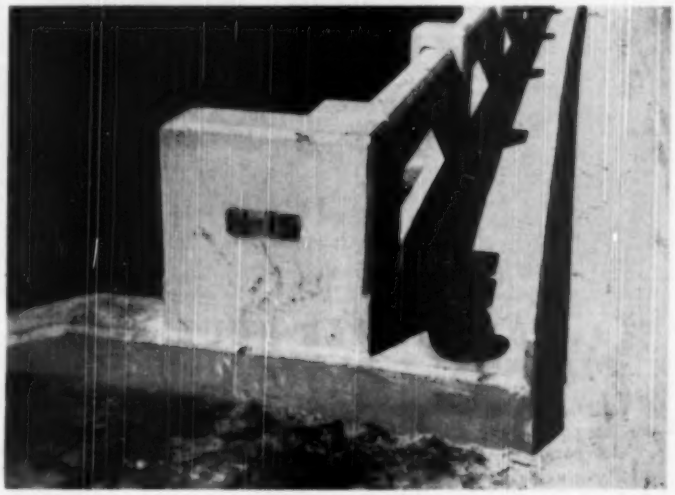
Toledo Expressway Plan Under Consideration

A 39-mile system of limited access highway routes serving the Toledo area has been proposed by the consulting firm of Howard, Needles, Tammen & Bergendoff. Estimated to cost $61 million, the scheme would flank downtown Toledo with two north-south routes and one east-west route. These locations would match up with Michigan's plans for an expressway north to Detroit, and would handle through traffic east-west on U.S. 20 between Cleveland and Chicago, as well as north and south along U.S. 25.

Bridge Load Limit Clearly Marked

Florida's newer bridges have an effective detail, it seems to us, in the form of a notice of the bridge's load classification stamped in the concrete endpost at either end.

The accompanying photo tells the story.



★ How much will this bridge carry? Highway engineers and maintenance men in years to come down in Florida will know at a glance whether this bridge is good for a given emergency permit load

Cost Estimating for

Bituminous Concrete

By E. T. Nettleton

Associate Highway Engineer, State Highway Department of Connecticut, Hartford

COST for construction of bituminous concrete pavements on different projects vary to a considerable degree. First, there is the difference in cost of the material used in the mixture itself and second, there is the difference in costs attributable to the project conditions and operations. In this article we will confine ourselves chiefly with the cost of laying the material on the job and not with the cost of manufacturing the mix.

In order to clarify what we are talking about, we shall define the term bituminous concrete pavement as a pavement the material of which is premixed or pre-manufactured in either an existing commercial plant or a local portable plant set up by the contractor. This pre-mixed material we shall call the bituminous concrete mixture. This mixture shall consist of bituminous materials and aggregates combined together, in controlled proportions in the bituminous mixing plant.

Hundreds of different bituminous concrete mixtures are known to have been manufactured. Regardless of the difference in the composition of the vurying mixes, there exists certain general facts which must be considered in order to properly estimate the cost of forming any of these bituminous concrete mixes into a finished bituminous concrete pavement upon any individual construction project. The chief factors to be considered in the estimation of any type of bituminous concrete wearing surface or pavement are as follows: (1) method of payment; (2) specifications; (3) plans; (4) project site; (5) material supply; and (6) job operations. These factors are herein taken up for consideration in the order as stated.

There is a great variation in the method of payment throughout the country. Twenty per cent of the states still pay on a square yard basis; however, the majority are now paying according to the quantities of material employed. This would appear to be the best procedure because it eliminates much of the argument with respect to thickness where square yard basis is employed and furthermore permits the engineer to make such adjustments as seem desirable, both with respect to width and thickness when payment is made on a quantity basis.

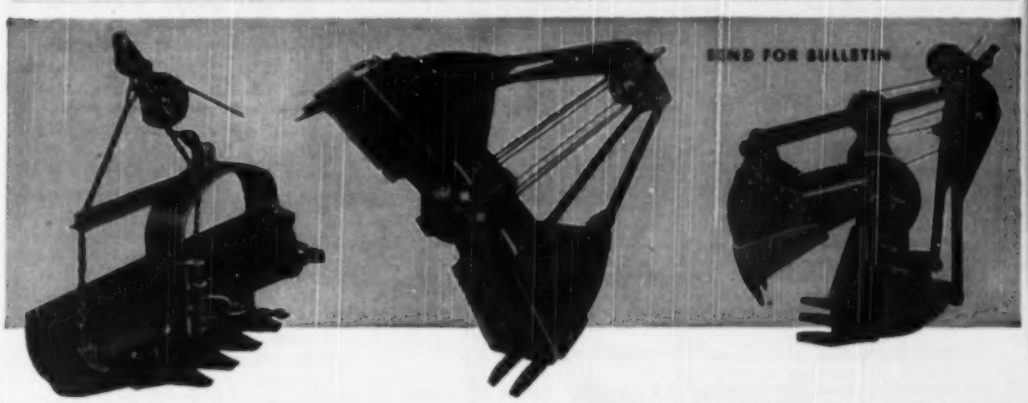
1—Is the wearing course to be paid for by the square yard?

(a) How much does the material compact under rolling?

(b) What is the cubic yards or tons of material required per square yard rolled depth?

(c) What per cent of material will be lost in over depth and waste?

2—Is the wearing course to be paid



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for by the cubic yard?

(a) Where is material measured?

(b) Who measures the material? Who pays the measurer?

3—Is the wearing course to be paid for by the ton?

(a) Where is the material weighed?

(b) Who weighs the material? Who pays the weigher?

(c) Who furnishes the scales—engineer? producer? or the contractor?

4—How is payment allowed for?

(a) Bituminous concrete gutters?

(b) Bituminous concrete lips?

(c) Bituminous concrete shoulder?

(d) Bituminous concrete feathered out intersection?

(e) Manhole, catch basins, etc. corrections?

Detailed Cost Estimate Form

Equipment Costs

	Mechanical spreaders @ ____ per day x ____ days	=
	Power rollers @ ____ per day x ____ days	=
	Power broom @ ____ per day x ____ days	=
	(sweeping old pavement or new base)	
	Bituminous spray spreader @ ____ per day x ____ days	=
	(applying tack coat if required)	
	Pick-up truck @ ____ per day x ____ days	=
	(signs, barricades and misc. work)	
	Pick-up truck @ ____ per day x ____ days	=
	(for mason on manholes, cleaning out old C.B. etc.)	
	Movable office and tool shed @ ____ per day x ____ days	=
	Barricades, lanterns and flares @ ____ per day x ____ days	=
	Compressors @ ____ per day	=
	Sub-total equipment costs	
	— % Profit and overhead	
	Total equipment costs	$

Material Costs

Royalty on material ____ tons @ ____ per ton	=
Bituminous concrete aggregate wearing surface ____ tons @ ____ per ton	=
Bituminous concrete aggregate wedge coat ____ tons @ ____ per ton	=
Stone dust ____ tons @ ____ per ton	=
Portland cement ____ bbls. @ ____ per bbl.	=
Ready mix concrete ____ C.Y. @ ____ per C.Y. delivered	=
Bituminous material (tack coat) ____ gals. @ ____ per gal. delivered	=
Chemical to gasoline proof surface (if required) ____ gals. @ ____ per gal. delivered	=
Side forms (if used) ____ b.f. @ ____ per M.B.F.	=
Gasoline for equipment and trucks ____ gals. @ ____ per gal.	=
Grease, oil and waste ____ lump sum	=
Sub-total material costs	
— % Profit and overhead	
Total material costs	$

Labor Costs

1 Superintendent (proportionate share)	@ ____ per day x ____ days	=
1 Timekeeper (proportionate share)	@ ____ per day x ____ days	=
Foremen	@ ____ per day x ____ days	=
Spreader operators	@ ____ per hr. x ____ hrs./day x ____ days	=
Power roller operators	@ ____ per hr. x ____ hrs./day x ____ days	=
Power broom operators	@ ____ per hr. x ____ hrs./day x ____ days	=
Bituminous spreader truck operators	@ ____ per hr. x ____ hrs./day x ____ days	=
Bituminous spreader spray operators	@ ____ per hr. x ____ hrs./day x ____ days	=
Jackhammer or pavement breaker operators	@ ____ per hr. x ____ hrs./day x ____ days	=
Masons	@ ____ per hr. x ____ hrs./day x ____ days	=
Laborers—spreading and raking	@ ____ per hr. x ____ hrs./day x ____ days	=
Laborers—tack coat on concrete curbs	@ ____ per hr. x ____ hrs./day x ____ days	=
Laborers—dusting, gasoline proofing	@ ____ per hr. x ____ hrs./day x ____ days	=
Laborers assisting masons	@ ____ per hr. x ____ hrs./day x ____ days	=
Laborers—hand tamping	@ ____ per hr. x ____ hrs./day x ____ days	=
Flagman	@ ____ per hr. x ____ hrs./day x ____ days	=
Sub-total labor costs		$
— % Social security, insurance, taxes		
— % Profit and overhead		
Total labor costs		$

(*Above table continued on page* 102)

Study of Specifications

1—What type of bituminous concrete mixture is to be used?

2—Is this a patented type of mixture?

3—If so, what is the royalty charge?

4—Is there any guarantee of maintenance on the pavement? For what length of time?

5—Is material placed hot? or cold?

6—Between what temperatures must the material be when laid?

7—What is the limiting temperature of the air below which it is not permitted to lay the material?

8—Are there any calendar dates between which it is not permitted to lay the material?

9—Can the material be laid in rain?

10—Can material be laid on wet base?

11—If the wearing course is laid in two courses how far ahead of the top course can the binder course be laid?

12—Do joints in the old concrete base have to be cleaned, cut off or repaired?

13—Is a tack coat required on old concrete pavement? on old concrete gutters? on old concrete curbs?

14—What methods are specified or allowed in dumping the material? direct into spreader boxes? direct into mechanical spreading machine? direct on to dumping boards? direct on to pavement?

15—What methods are specified or allowed in spreading the material—use of spreader box? use of mechanical spreading machine? hand spreading?

16—Will side boards along pavement strips be required or used?

17—If not, will feathered edges from first strip have to be chipped off vertically before the next strip is laid?

18—Will this chipped material and that feathered out at the end of each day's run be wasted? How much material does this amount to? Will payment be allowed for it?

19—What type of rolling is specified or allowed? tandem? three wheeled? roller on spreading machine?

20—What spec. gross roller weight of roller?

21—What is the specified weight per inch of roller? If the first rolling is done by a roller built into the spreading machine the compression per inch of roller shall not be greater than the compression per inch of finishing roller.

22—What are the limitations on the rate of rolling per hour?

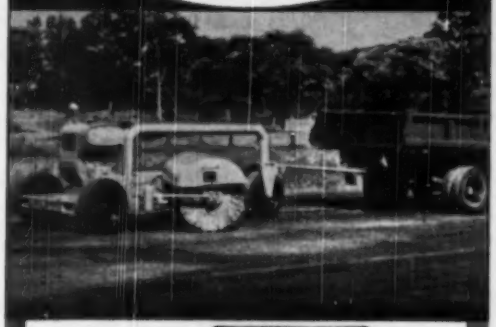
23—What is the specified smoothness of the finished surface? ⅛" in 16 feet? ½" in 10 feet? or what?

24—Does the finished pavement surface have to be "proofed" against gasoline and oil drippings?

25—Does the finished pavement have

hydraulic raising and lowering system is found only on

★LITTLEFORD HIGHWAY BROOMS



Traction Driven Broom model no. **106**

LITTLEFORD Power Driven Model 108 and Traction Driven Model 106 Highway Brooms have the Hydraulic System for raising and lowering the Broom—and too, this hydraulic system saves wear on the broom, because the tension on the road surface can be regulated. There's no need to have the full weight of the broom resting on the road surface.

model no. **108** *power drive*

MONO-FRAME CONSTRUCTION of the Littleford Highway Brooms makes these units sturdy, yet light weight, gives the operator better vision of the broom, makes it easy to handle and shortens the turning radius.

TWO-WAY BROOME—Both Littleford Brooms can sweep in either direction and it takes only 30 seconds to change from one direction to the other. Both models can be equipped with Sprinkler System and model 108 Power Driven can be equipped with a Dust Blower Unit.

MANUFACTURERS OF
"Tankar" Steam Heaters
"Kwik Melter" Roofers Kettles
Trail-O-Rollers
"Spray Master" Pressure Distributors
Highway Brooms
Tool Heaters
Trail-O-Distributors
Asphalt Supply Tanks
No. 101 Utility Spray Tanks
84-HD Asphalt Kettles

LB LITTLEFORD

LITTLEFORD BROS., Inc.
454 East Pearl St., Cincinnati 2, Ohio

First low-cost machine that accurately lays base and surface aggregates, free-flowing bituminous mixtures and plant mixed stabilized soil.

IT'S HERE! Jaeger self-propelled aggregate spreader

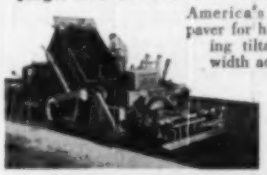
Accurately Lays up to 10" Thickness, 8 to 12½ Ft. Widths: Four-wheel drive operates entirely on subgrade or compacted base — prevents displacement of newly-laid material. Long straightedge runners carry screed independent of up-and-down machine motion, average out subgrade irregularities, positively maintain correct course thickness.

Quick Width Changes: 10' to 12½' by telescopic shaft, screed inserts. Block off for 8' to 10'.

Blends Perfect Joints Between Lanes with blender wings and side control gates. Saves hand work.

Tandem Spreaders Lay Full-Widths up to 25', Ready to Roll in One Operation: Two spreaders cost much less than one big bituminous paver, double your daily production of base, permit earlier application of top and keep your higher priced paver busy finishing top course — at tremendous savings to you. Send for Catalog SPS-9, giving complete details.

Jaeger Bituminous Paver "Teams" with Jaeger Spreader. America's most modern bituminous paver for high precision work—oscillating tiltable screeds, almost instant width adjustability to 12½', positive automatic leveling. Can pave flush to curb, gutter or previous lane. Confines all traction and heavy load to subgrade. Ask for Catalog BP-9.



THE JAEGER MACHINE CO., Columbus 16, Ohio

Leading distributors in 130 cities of the United States and Canada sell, rent and service the Jaeger equipment listed below.

PUMPS • MIXERS • HOISTS • TOWERS
CONCRETE and BITUMINOUS PAVING MACHINES

to be dusted with portland cement, lime or stone dust?

26—How long after the finished rolling must traffic be kept off?

Study of Plans

1—Is the wearing course to be constructed in one or two courses? What is the rolled depth of each course?

2—Is a wedge course to be placed?

3—What is the width of surface?

4—How will this width divide up into multiples of capacity widths of mechanical spreaders?

5—Is the normal width maintained throughout the project?

6—Are curves to be widened? Will widening have to be put in by hand?

7—Are widened intersections prevalent? Will these have to be hand feathered?

8—Are existing curbs and gutters to be encountered?

9—Are new gutters (not in pavement cross section) to be constructed of bituminous concrete?

10—Are new retaining lips to be constructed of bituminous concrete?

11—Is the wearing course to be constructed on a rigid base? a solid base? or a more or less flexible base?

12—What is the per cent which the loose material will compress under the action of the roller?

13—Will the finished crown on the road be so great that a mechanical spreader cannot be used?

Study of Site

1—What are the traffic conditions to be encountered?

(a) Can the project or any part of the project be closed to through traffic? to local traffic?

(b) Are detours available?

(c) Will access crossings have to be maintained for fire departments? filling stations? other businesses? individual property owners?

(d) Is there heavy pedestrian traffic from factories, stores or offices to contend with? for how long a period?

2—How much will traffic (vehicular and pedestrian) interfere with the contractor?

3—Will one way or two way traffic be maintained?

4—How many manhole covers must be raised or lowered?

5—How many catch basin covers must be raised or lowered?

6—How many utility covers must be raised or lowered?

7—Will these changes in elevation for these covers require any of the following work?

(a) Removal of present pavement?

(b) Removal of present concrete base to cover?

(c) Replacement of new concrete base to cover?

(d) Do covers have to be reground or reset?

8—Is it advisable to change elevations in covers before or after new pavement is laid? This may depend upon the type of spreader used or the timing of work operations. Will hand feathering be required?

9—Are there any excessive grades where rolling will be difficult?

10—How much hand tamping?

11—How many dead haul movements will have to be made of finishing or spreading machines over sections of roadway which are not to be surfaced?

12—Where can water be obtained for the rollers?

13—Are there old abandoned trolley rails on the project to contend with?

Sources of Supply

Costs of manufacturing the bituminous concrete mixture will not be discussed herein. It will be assumed that the contractor is in a position to obtain this material from a reputable producer and that the contractor will not set up his own bituminous concrete plant for the project.

1—Where will bituminous concrete material meeting specifications be purchased from? a commercial producer? at what price?

2—What is the daily capacity available from the producer?

3—What method of shipment?

(a) Truck? Hauling distance?

(b) Railroad? Rehandling point? Truck haul distance?

(c) Water? Rehandling point? Truck haul distance?

4—Will the contractor have to set up rehandling facilities?

5—How is payment made to the commercial producer by the square yard? the cubic yard? the ton?

6—Whose measurement accepted?

7—Must truck bodies be insulated?

(*Table continued from page 100*)

Job Overhead Costs

_____ Mechanical spreaders to project and back _____
_____ Paver rollers to project and back _____
Maintenance guarantee (if any) _____
Total job overhead costs _____
— % Profit and business overhead _____
Total overhead costs $ _____

Summary of Costs

Total equipment costs _____
Total material costs _____
Total labor costs _____
Total job overhead costs _____
Total cost of wearing surface $ _____

$_____ Total cost of wearing surface _____ = $_____ cost per S.Y.
_____ No. of square yards on project

$_____ Total cost of wearing surface _____ = $_____ cost per C.Y.
_____ No. of cubic yards on project

$_____ Total cost of wearing surface _____ = $_____ cost per Ton
_____ No. of tons on project

Job Overhead Costs

_____ Mechanical spreaders to project and back _____
_____ Paver rollers to project and back _____
Maintenance guarantee (if any) _____
Total job overhead costs _____
— % Profit and business overhead _____
Total overhead costs $ _____

Summary of Costs

Total equipment costs _____
Total material costs _____
Total labor costs _____
Total job overhead costs _____
Total cost of wearing surface $ _____

$_____ Total cost of wearing surface _____ = $_____ cost per S.Y.
_____ No. of square yards on project

$_____ Total cost of wearing surface _____ = $_____ cost per C.Y.
_____ No. of cubic yards on project

$_____ Total cost of wearing surface _____ = $_____ cost per Ton
_____ No. of tons on project

8—Will truck loads have to be covered by tarpaulins?

9—Will steam jetting be required in unloading water or rail shipments?

Job Operations

1—What is the total tonnage of bituminous concrete on the project?

2—What is the total tonnage to be spread by machine?

3—What is the total tonnage to be spread by hand?

4—What type of mechanical spreader will be used?

5—What is the width of spread?

6—How many lanes will have to be laid?

7—Is the mechanical spreader on wheels or continuous tread?

8—Can the spreader be satisfactorily manipulated over raised manhole covers?

9—Can the spreader satisfactorily work to the specified finished crown of the pavement?

10—What is the theoretical capacity of the spreader in tons per hour?

11—What is the expected practical capacity of the spreader assumed for this project when the following time losses are considered?

(a) Dumping time
(b) Awaiting material
(c) Mechanical failure, adjusting machine
(d) Wet subgrade, cleaning subgrade
(e) Rainy weather
(f) Dead hauling and manipulating around structure
(g) Getting too far ahead of rollers and tampers

12—What is the estimated number of square yards which will be laid per hour? per day?

13—How many mechanical spreaders will be used?

14—How many power rollers will be used?

15—How many full working days will be required for machine spreading?

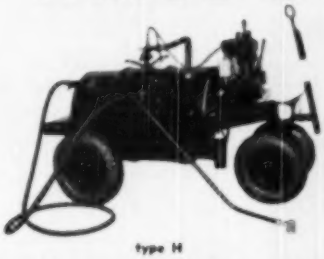
16—How many full working days will be required for hand spreading?

In ordinary hand raked work even with careful supervision there is a loss or excess of material used, due to uneven spreading of base or surface. The use of machines may save from 3 to 10 per cent of material.

17—How many full working days will be required for miscellaneous work?

18—How many flagmen will be required at any one time?

TARCO'S



type H

"Direct from the Shipping Drum"

SPRAYER

Spray bituminous materials by air pressure. Emulsions direct from the barrel. Heavier materials requiring heat sprayed by air through TEMPERING TANK attachment.

Ideal for street and highway maintenance. Practical for small construction: parking areas, walks, driveways, etc. Will also handle curing materials, insecticides, and oil paints.

FAST - CLEAN - ECONOMICAL

TARRANT MFG. CO.
Saratoga Spa, N. Y.

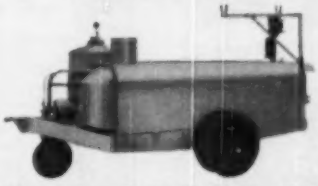
More Miles Swept per Dollar

Plenty of tough fibre and extra large diameter means extra mileage on Grace brushes.

with 36" diameter brush in

GRACE SWEEPERS

More Asphalt Heated per Hour with RAPID FIRE HEATER



10,000 GAL. INSULATED TANKS HEATED UP TO 60° per hour

W. E. GRACE MFG. CO.

6007 S. Lamar St., Dallas, Texas

Kinney Bituminous Distributors

FOR HIGHWAYS AIRPORTS STREETS

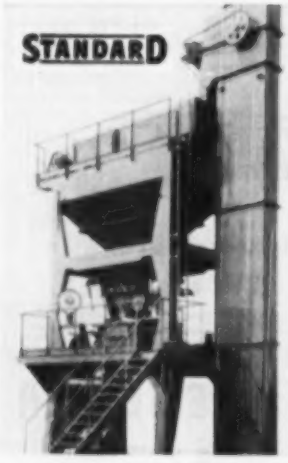
You can count on Kinney Bituminous Distributors on every kind of job, large or small, new construction or old. They work fast and accurately — apply all grades of bitumen: oils, tars, asphalts, or emulsions. If desired the Fraco Circulating Hot Spray Bar can be furnished. Kinney Distributors have many exclusive features. Write for Bulletin A-49.

KINNEY MANUFACTURING CO.

3537 Washington Street
Boston 30, Mass.

New York Chicago Cleveland
Philadelphia Los Angeles

We also Manufacture Liquid Pumps and Vacuum Pumps



AMERICA'S NEWEST PAVING PLANT

STANDARD, one of the oldest and largest builders of paving plants, announces its newest plant. Seven sizes. Unit-built. Prompt delivery.

Write for catalog.

STANDARD STEEL CORPORATION
5003 Boyle Avenue
LOS ANGELES 11 CALIFORNIA

54
Distributor: Littleford

A new low-priced pressure distributor, the "Spray King," announced by Littleford Bros. Inc., 454 East Pearl St., Cincinnati, O., is stated to have features previously found only on deLuxe units. These features consist of a choice of end-folding spray bars, both full circulating and standand suck back, low pressure atomizing or vaporizing torch type burners, single valve control, heat chamber for pump and valves, flue liners in main flues, two 8 in. U-type heat flues, 28 hp engine with clutch and four speed transmissions, mechanical lift for adjusting spray bar for height, catwalks, filler connection in rear of machine, hand spray attachment, 375 gal. per minute pump at 375 r.p.m., and inside closing valve.

PORTABLE ASPHALT PLANTS
High Production—Low Cost

THE McCARTER IRON WORKS, INC.
NORRISTOWN, PENNA.

1949 Major Bituminous Equipment Developments

55
Distributor: Etnyre

What is believed to be the largest bituminous distributor ever made using stainless steel jacketing and heads in the construction was designed, engineered and manufactured by E. D. Etnyre & Co., Oregon, Ill. A fleet of these machines was delivered recently to the Barrett division of the Allied Chemical and Dye Co., specially constructed to their specifications. These "Black-Toppers" carry 3500 gal. and were engineered to take a maximum load yet comply with weight requirements of the states in which they will be used. Basically, each machine is an Etnyre FX-400 Style D distributor having low pressure burners and a 24 ft. full circulating spray bar with relieving sections. The tank proper is 32 ft. 6 in. long with heating flues running the entire length of tank. The equipment is mounted on a specially engineered highway tandem axle semi-trailer.

56
Chip Spreader: Gabb

Trucks spreading chips in the wake of the bituminous distributor can travel forward while spreading, yet avoid tracking through the fresh application by use of a new device called the "Roadsaver." Manufactured by Gabb Manufacturing Company, 16 Orchard St., East Hartford, Conn., the equipment is a surface material spreader which fits under the chassis of an ordinary dump truck. A frame extends under the truck, and on it, in the rear, is mounted a hopper which receives material from the tailgate. Material passes under the truck along an endless belt, to a spinner with power unit mounted in front.

57
Bituminous Spreader: Overman

A new light weight spreader for laying plant mix bituminous paving materials was developed by I. J. Overman Manufacturing Co., 3301 South Torrance St., Marion, Ind. The spreaders are made in two sizes to provide for 8 and 10 foot spreads. Each spreader is equipped to regulate the spread from 1 to 4 in. in depth. The spreader is towed behind dump truck which feeds the materials into the spreader box and preliminary compaction is obtained by adjustable rollers attached to the rear of the spreader itself. The adjustable rollers are stated to make an even contour of the pavement, either with or without a crown.

58
Asphalt Surface Heater: Asphalt Maintenance Co.

A new Clarkmore asphalt surface heater, brought out by Asphalt Maintenance Co., 41 Park Row, New York 7, N. Y., will, it is claimed, successfully remove to an average depth of 1 in., 3500 sq. yd. of asphalt pavement in an 8-hour period. The surface heater unit is mounted on a 2½-ton Diamond T truck chassis built for power at low speed (2 m.p.h.). All controls are located in such manner that the operator can operate and move the machine forward without the necessity of

entering the cab of the truck. The heating hood is manufactured in sizes ranging from 5 ft. to 8 ft. with protecting guard for trees and low hanging foliage. The volume of air and fuel oil can be regulated or controlled in such manner that almost any size area can be heated that is desired.

59
Travel-Mix Plant: Gardner-Byrne

A one-pass traveling mixer stated to have a capacity of 600 to 750 tons per hour, developed for emulsion or cement stabilization and for bituminous road mix paving, was placed in production by Gardner-Byrne Construction Co., Inc., 649 South Olive St., Los Angeles, Calif. Self-powered by a 135 h.p. Diesel motor and with complete hydraulic one-man control, the mixer can be fitted to the purchaser's tow-tractor or it is offered in combination with a tractor.

60
Spreader: Grace

A spreader for hot or cold mix asphalt or stone base courses was added to the line of asphalt equipment made by W. E. Grace Manufacturing Co., Dallas, Tex. The device is drawn by a truck, which dumps its load in the spreader and travels forward to spread the material. Attachment to almost any make truck is possible by an inexpensive quick acting hitch clamped to the truck axle. Wheels carrying two 6.00-9 six-ply tires adjust vertically to take part of the load, provide a leveling action, and raise the spreader clear of the surface for transporting or backing. Depth of spread is adjustable from 1 to 8 in. Widths furnished are 7 and 9 ft.

61
Bituminous Paver: Jaeger

An improved BP-5 bituminous paver announced by Jaeger Machine Co., Columbus 16, O., lays any width of paving between 5 ft. 8 in. and 12 ft. 6 in. without removal or insertion of any parts. It also is stated the paver can lay 25 ft. pavement in two lanes without special attachments. It is almost instantly adjustable for any width between 9 ft. and 12 ft. 6 in. by merely turning a handwheel and without stopping the machine. Width settings from 5 ft. 8 in. to 9 ft. are made by merely turning levers that control block-off gates. Center and rear screeds oscillate at 900 strokes per minute, have beveled front edges that are V-grooved in the direction of travel. The screeds are tiltable—either the leading or trailing edges may be raised. Quick crown changes ranging from 2 in. convex to 1 in. concave are achieved by cranks located above the screeds.

New 1950 Bituminous Equipment and Materials

62
Mobile Aggregate Heater

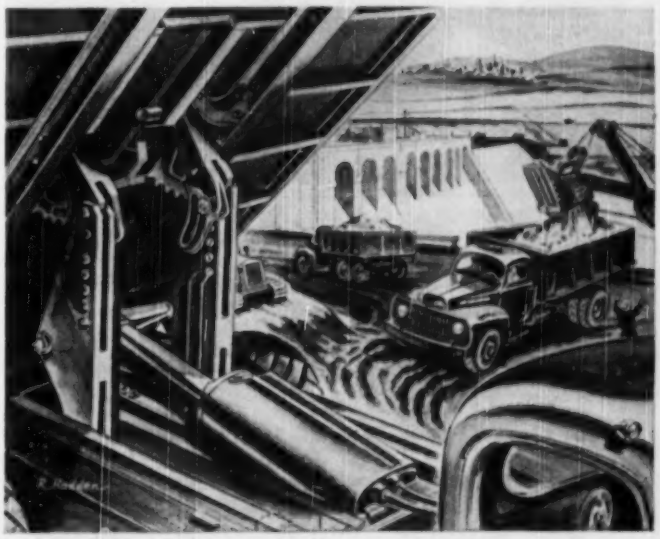
An aggregate heater announced by Tarrant Mfg. Co., Saratoga Spa, N.Y., is trailer mounted on four pneumatic tired roller bearing wheels. The hexagonal heating drum is fitted with angular tumbling irons and revolves easily on four Oilite-bushed rollers. Frame is rigid-all welded. An air-cooled, throttle-governed engine housed in a metal compartment revolves the heating drum by means of steel chain

GALION Allsteel

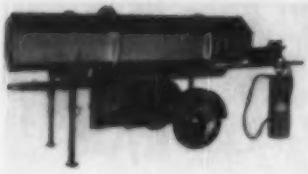
HOISTS and DUMP BODIES are "Job-Engineered" For maximum payload service

For fast, economical handling of loads from 2½ to 25 tons, equip trucks with Galions. Over the past 25 years they have earned a reputation among contractors and operators to stand up best even on the toughest materials handling jobs. And Galion's improved equalizing double lift arm hoists are unparalleled for dependable maintenance-free service. To speed up 1950 material handling contracts see your local truck dealer or Galion distributor about Galions' "job-engineered" superiority or write for bulletin G 49.

The GALION Allsteel Body Co., Galion, Ohio



GALIONS Lift More . . . Last Longer



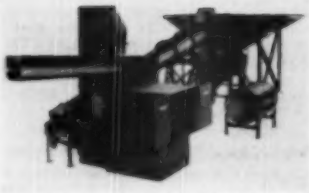
Tarco's Mobile Aggregate Heater

drive. Fuel tank carrying rings are welded to frame. Operation is simple. Wet stone, sand, or gravel is shoveled or dumped into the high (34 in) end of the slowly revolving heating drum. Material is mixed and progressed by a series of angular tumbling irons through heat supplied by a large swivel mounted kerosene burning torch. Hot and ready for use, the aggregate falls into a barrow or stock pile.

63

Bituminous Mix Plant

A new continuous, bituminous hot-mix plant is now being manufactured by the Wayne Crane Division, American Steel Dredge Co., Inc., Fort Wayne, Ind. The M-20, having a 20-ton per hour capacity, is the first model to go into production. Known as the Wayne Monotrol Model M-20, it is designed for 1-man control. All functions of the plant are electrically operated from a single control panel. The entire plant is built in sections which are easily assembled "on the job" and as easily disassembled for changing location of the



Wayne Monotrol Model M-20

plant. The largest single unit weighs 3000 lbs. Positive control of the quality of the mix is the most important feature of the new machine. Accurate proportioning and thorough mixing of the bituminous materials are insured by several patented mechanical devices. An individually controlled volumetric-type feeder valve for each raw aggregate bin compartment permits accurate proportioning in any specified percentage. A 3-section rotating dryer prevents segregation and can eliminate up to 100% of the moisture if required.

64

½-Yd. Excavator

A new heavier Model Unit 614 ½-yd excavator added to the line of Unit Crane & Shovel Corp., Milwaukee, Wis., is convertible to all attachments. It has a crane capacity of 6 tons at a 12-ft. radius. Conforming to the same construction standards as the company's larger capacity models, this new machine has newly improved hook-roller design. Twin hook-rollers are equalized and mounted on the front and rear of the rotating frame, quickly adjusted by means of eccentric pin. There are 4 upper load-rollers plus 4 hook-rollers. All rollers are conical shaped and made of drop-forged steel.

Unit 614 ½ yd. Excavator

Outstanding in design is the completely new shovel attachment. The boom is a heavy weldment with sturdy box-section side members. Cast steel hinges give added strength to the boom foot. Dipper stick is a single, rigid, square structural section, sliding through a heavy cast steel saddle-block, having adjustable and replaceable wearing plates. A GMC diesel and a Chrysler 8 cylinder industrial gasoline engine are standard power installations, regulated to produce better than average horse-power for ½ yd. machines. Paired with the Unit 614, is another new model known as the Unit 617. It is available as a ⅝ yd shovel, and compared with the Unit 614, has a longer boom and stick, longer crawlers, standard 22 in. shoes, larger drums, and greater horse-power.

65

¾-Yd. Shovel

A new machine in the ¾-yd. class, the Lorain TL-25, now in production by The Thew Shovel Co., Lorain, O., has a turntable design such that it is comprised of

LOOK...THIS EAGLE LOADER HANDLES 5 YARDS PER MINUTE...EASILY

For handling any loose material—coal, cinders, slag, dirt, snow, etc., here is your economy answer:

One man operated—moves quickly from job to job at highway speeds.

Write for complete specifications: Dep't. RS-3.

EAGLE CRUSHER CO., Inc. GALION OHIO-U-S-A

JAW CRUSHERS • IMPACT BREAKERS PULVERIZERS • CONVEYORS • LOADERS

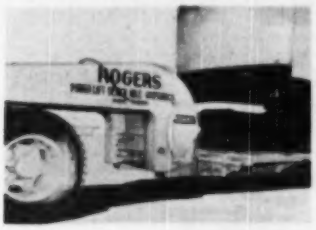
Lorain TL-25

several major components. Each of these components is built on its own separate assembly line as an integral unit, complete with all sub-assemblies and parts installed. Such major components are installed on the turntable as complete assemblies and may be removed as such, and replaced with new complete assemblies, either temporarily to keep the machine going or as replacement units. The Lorain TL-25 offers many other standard features including electric starter and operating lights; five identical clutches to control all machine operations; one-piece, all-welded turntable bed; hook rollers mounted on drop-forged brackets with centralized pressure lubrication; machine cut internal ring gear

66

Trailer Has Detachable Gooseneck

A new power lift detachable gooseneck trailer with exclusive deck-raising and deck-lowering features of operation has been announced by Rogers Brothers Corp., Albion, Pa. In addition to the removable gooseneck feature which greatly facilitates rapid, easy loading and unloading, exclusive new Rogers features of design and construction make possible the lowering of the trailer deck when loaded, to clear overhead obstructions and the raising of



Loaded Trailer with Deck in Normal Position for Traveling

the deck to clear railroad embankments and other roadbed obstructions. Deck raising and lowering is accomplished quickly by means of a cable operated ram driven by the tractor winch. Larger diameter tires can be used on the rear to carry heavier loads legally at greater speeds. Shorter and lighter ramps are used for loading at a lower than conventional angle. Despite its detachable feature, the new removable gooseneck is as rugged as the standard Rogers gooseneck. It is available on most Rogers trailers from 15 tons capacity up.

67

Bucket Loader

A new pneumatic-tired Model 543 bucket loader has been added to the line of

B-G Model 543 Swivel Conveyor Bucket Loader

"constant flow" material handling equipment of Barber-Greene Co., Aurora, Ill. This new bucket loader is stated to handle capacities of up to 2 cu yd per minute. An outstanding feature, especially to those who have widely scattered stockpiles, is the 15 M.P.H. road speed of the 543. Steering, through a truck type worm and roller, is as simple as driving your truck, and allows easy maneuvering in cramped places. Two forward and two reverse speeds allow operator to compensate for material being handled and power requirements. High reverse gives fast out-of-pile speed to escape cave-ins. An interesting advantage claimed for the new Model 543 truck loader is automatic load trimming possible with the power hydraulic controlled swivel loading conveyor. Designed to extend the advantages of specialized truck loaders, B-G engineers have mounted the solid plate elevating boom on a tractor-type pneumatic-tired chassis.

68

Air Compressor

Low first cost, light weight, and the utmost simplicity in servicing are claimed for the new Le Roi Liquid-Cooled 105

It Picks a UNIT to do the Job!

Yes . . . it's really amazing what you can do with a UNIT Crane or Excavator. Take a UNIT 357 Mobile Crane, for example. It travels anywhere! Any time! Powered by ONE engine . . . controlled and operated by ONE man. Compact, it has light-truck mobility — the smoothest operating and easiest handling crane made. Works efficiently even in small yards where space is limited. FULL VISION CAB gives operator complete visibility in all directions.

UNIT 357 is self-propelled . . . mounted on six pneumatic tires . . . duals on the rear . . . singles on the front. Balanced weight distribution keeps entire undercarriage on ground while working. Dimensions meet all highway requirements. Get the complete UNIT 357 story. Write for bulletin.

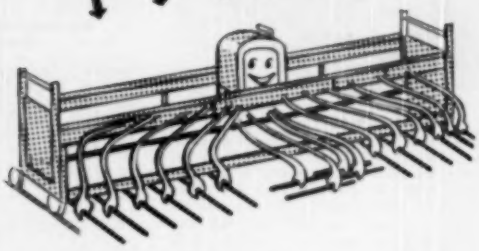
UNIT CRANE AND SHOVEL CORP.

6407 WEST BURNHAM STREET • MILWAUKEE 14, WISCONSIN, U. S. A.

SHOVELS • DRAGLINES • CLAMSHELLS
CRANES • TRENCHOES • MAGNETS

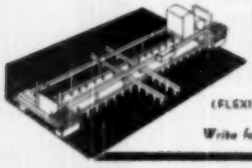
You Make
More Money
Selling ANTHONY
TRUCK EQUIPMENT
● GET REPEAT SALES because of user satisfaction.
● Anthony features give you more selling advantages.
● Anthony line is complete.
● Anthony nationwide distributor sales-service organization serves you.
ANTHONY CO.,
STREATOR, ILL.

that FLEX-PLANE BAR INSTALLER DEMONSTRATES $AVING GENIUS



Eliminates use of expensive dowel holding devices. Vibrates dowels and tie-bars to exact position in plastic concrete; forms transverse joints and cuts and installs longitudinal joints . . . all in one operation.

It has made money for other contractors. Before you bid, investigate the Flex-Plane Mechanical Bar Installer.



FLEX-PLANE
WARREN OHIO
(FLEXIBLE ROAD JOINT MACHINE CO.)
Write for Bulletin K-10-Q

Yours for Only $1.00

This NEW Time-Saving Keely
PLYFORM CALCULATOR

SAVE time designing and building forms of PlyForm, the concrete form grade of Douglas fir plywood. Handy slide-rule calculator gives construction data, based on hourly rate of pour. Included is booklet, "Design Assumptions for New Keely Calculator." Clip coupon — now!

DOUGLAS FIR PLYWOOD ASSOCIATION Dept 5
Tacoma 2, Washington

Offer good in U. S. only.

Please send me ..... Keely PlyForm Calculators.
I enclose $1.00 each to cover costs.

Name .....

Address .....

City ..... Zone ..... State .....

☐ Also please send me, at no cost, copies of "Concrete Forms of Douglas Fir Plywood", and "Handling PlyForm".

RUEMELIN *Portable*
SAND BLAST GENERATORS

FOR CLEANING BRIDGES — WATER TOWERS — STRUCTURAL STEEL

Many contractors use Ruemelin Blast Generators for cleaning steel work to remove rust, paint and scale before repainting. These machines are also used to remove laitance from cement wherever concrete construction is in progress. A wet adapting nozzle can be furnished to convert dry machines to wet type of operation.

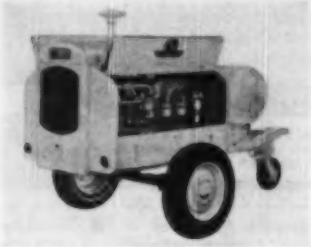
Ruemelin Generators are built in several sizes, 400 lb. to 10,000 lb. capacity. Single or two hose outlets. We can care for your complete requirements, including blast hose, tungsten nozzles, operators' helmets.

•

Agents in principal cities. Prompt shipment on most sizes. Write for Bulletin 36-B.

RUEMELIN MANUFACTURING CO.
2990 N. PALMER ST. • MILWAUKEE 12, WIS., U.S.A.
Manufacturers and Engineers SAND BLAST AND DUST COLLECTING EQUIPMENT, WELDING FUME COLLECTORS

"Airmaster" of Le Roi Co., Milwaukee, Wis. In this liquid-cooled design Le Roi employes the one-pieces engine-compressor block construction, with common crankshaft, cooling system and lubrication systems. Low first cost is stated to stem from the integral engine-compressor design which also contributes to the absolute ease of operation and servicing set



Le Roi Liquid Cooled 105 Airmaster

as an objective in the development of the Liquid-Cooled "Airmaster." The operator has but one control—the starter switch. The new unit weighs only 1990 lb. The compressor develops its 105 C.F.M. at a speed of 1100 RPM, which involves a low piston speed consistent with minimum wear of the unit.

69
Converting Motor Grader to Elevating Grader

A new product for easily converting a "Caterpillar" motor grader into a one-man self-propelled elevating grader has been placed on the market by the Ulrich Products Co., Roanoke, Ill., in cooperation with the Caterpillar Tractor Co., Peoria, Ill. Sold under the trade name Domor, an Ulrich Products Corp. trade-

Domor Attachment on Road Grader

mark, the new attachment will be marketed through "Caterpillar" dealers. In making the conversion the standard blade, circle and drawbar are removed and the elevating carrier adjustably supported under the main frame. A 30-in disk plow is drawn by a plow beam attached to the standard drawbar connection. The 42-in carrier is driven by power take-off from the motor grader engine and has a normal speed of 400 feet per minute. It is equipped with a four ply corrugated top conveyor belt, firmly connected by metal hinges. Carrier rollers are mounted on ball bearings. An efficient, auger type pan cleaner is driven by well-protected gears. The standard carrier is 19 feet in length, giving ample heights for loading.

70
New 4-Ton Dodge Truck

Its line of "Job-rated" trucks in the high tonnage field has been expanded by Dodge

New Dodge 4-Ton Truck

Division, Chrysler Corporation, Detroit, Mich., to include a 4-ton heavyweight. This entirely new and more powerful truck is being introduced in 30 basic models. Designated as the Y and YA models, the new trucks have a nominal rating of four tons, a gross combination weight of 50,000 lb., and a gross vehicle weight of 28,000 lb.—an increase of 5,000 lb. over the 23,000-lb. maximum GVW formerly offered by Dodge. A completely new engine that develops 220 pound-feet gross torque was specially designed for the new 4-tonner. The six-cylinder engine delivers 154 gross horsepower, has a compression ratio of 6.5 to 1, and a displacement of 377 cu. in.

71
Wheelscrapers

The rotary wheeled scrapers and the "roto carry" scrapers of the Atlas Scraper and Engineering Co., 6203 Maywood Ave., Bell, Calif., are illustrated and described in two bulletins issued by this company. Three models of the rotary wheeled scrapers are shown in one

Now...
better joint maintenance
at less cost!
FAST
RUGGED
DEPENDABLE
As proved by highway depts. in many states, a Tennant Joint-Cleaning Machine now makes modern joint resealing possible... so pavement joints can now have dependable year 'round protection. This means less cost-per-mile for annual maintenance... smoother joints... fewer heave-ups... longer pavement life.
SAVES TIME... ASSURES BETTER BOND
Powered by a 13½ h.p. engine and guided by one man, this machine's high speed cutter head whisks old seal out of joints or cracks... simultaneously cleans and roughens sidewalls to allow a good bond with new seal.
With one of these machines you're equipped for 8 different jobs in pavement maintenance... including leveling bumps, cleaning irregular cracks, removing traffic lines, scoring surfaces to improve traction, etc.
Write today!
Get the facts about this machine... and how it has PAID FOR ITSELF ON A SINGLE JOB in some cases.
G. H. TENNANT CO.
2578 N. 2nd Street
Minneapolis 11, Minn.
CUTTERS are equally spaced to clean joints from ⅜" to 2¼" wide or more. Very durable.
CLEANING irregular crack is easy as cutters follow winding fissure. No skill needed.
EXTRUDED MATERIAL shaves off instantly with 4" cutting head. Leaves smooth surface.
TENNANT
Joint Cleaning Machines

OWEN
CLAMSHELL BUCKETS
BUILT A BIGGER DAY'S WORK
Exclusive features, expert design and superior construction characterize Owen buckets. Long life with dependable service has resulted wherever Owens have been put to work.
The latest catalog is now available. You'll doubtless want to look it over, keeping your current excavating, material handling and dredging equipment demands in mind. Write for the catalog TODAY
The OWEN BUCKET Co.
6070 Brookvale Avenue Cleveland, Ohio

of the bulletins, and operation, construction features and specifications are given. These scrapers range in capacity from 30 cu. ft. to 100 cu. ft. The other bulletin contains illustrations and descriptions of three models of "roto carry" scrapers. These scrapers have a rated capacity ranging from 37 cu. ft. to 56 cu. ft. Construction and operating details are given, as well as specifications.

72

16-E Twinbatch Mixer

The rubber tire mounted Koehring 16-E Twinbatch, latest development in the Koehring line of mixing equipment, is discussed in detail in a new catalog recently published by the Koehring Co., Milwaukee, Wis. The bulletin points out several features incorporated in the design of the new machine: rubber tired mobility at speeds of more than 6 mph; hydraulic power steering controlled from operator's platform; a 60 degree elevating boom that provides for controlled bucket discharge up to a height of 21 ft; the fast charging 7 second skip hoist and exclusive Koehring Autocycle timing for split second mixing controlled by Batchmeter. Along with a comparative production and capacity chart, detailed dimensions and specifications are listed in the bulletin.

Quick Help on Product Information

1. For latest information on any product you need in road-building, earth moving, heavy construction, etc., check items on this page, fill out coupon, clip page, and mail. If convenient, use typewriter or print. Or attach to your business letterhead. Give particular type, model, capacity, or other specific data on the blank line below. The blank line can also be used for naming items not listed. Address ROADS AND STREETS, Reader Service Department, 22 West Maple Street, Chicago 10, Illinois.

2. If you prefer, instead of mailing coupon, use business-reply card inserted in this publication. Just fill in our code numbers on blank lines, tear out, and mail.

3. See also other uses of cards for obtaining data on any products or literature advertised in this issue of Roads and Streets.

4. Cards are also usable for further information on any items described in the "New Equipment and Materials" or "Manufacturers' Literature" sections—see back part of magazine.

Check products below on which you wish us to obtain information for you:

I AGGREGATE:
- ☐ 1 Bins and Hoppers
- ☐ 2 Conveyors
- ☐ 3 Crushers
- ☐ 4 Portable Plants
- ☐ 5 Screens

II BITUMINOUS:
- ☐ 6 Batchers
- ☐ 7 Finishers
- ☐ 8 Distributors
- ☐ 9 Dryers
- ☐ 10 Heaters
- ☐ 11 Plants (central)
- ☐ 12 Plants (travel)

III CONCRETE:
- ☐ 13 Batchers
- ☐ 14 Buggies and Carts
- ☐ 15 Finishers
- ☐ 16 Joints, Exp. and Contr.
- ☐ 17 Mixers (under 1 yd.)
- ☐ 18 Mixers (1 yd. up)
- ☐ 19 Pavers
- ☐ 20 Reinforcing Steel
- ☐ 21 Road Forms (1000' set)
- ☐ 22 Tower
- ☐ 23 Truck Mixers

IV CRANES:
- ☐ 24 Crawler Mounted
- ☐ 25 Truck Mounted
- ☐ 26 Piledrivers

V GRADERS:
- ☐ 27 Blade, self propelled
- ☐ 28 Blade, pull type
- ☐ 29 Blade, under truck
- ☐ 30 Elevating

VI LOADERS AND TRENCHERS:
- ☐ 31 Front-end loader (tractor mounted)
- ☐ 32 Loader, bucket type and belt type
- ☐ 33 Trencher or Ditcher

VII HAULING EQUIPMENT:
- ☐ 34 Dump Truck
- ☐ 35 Other Trucks
- ☐ 36 Dump Wagons, tractor drawn
- ☐ 37 Flatbed Trailers

VIII PUMPS:
- ☐ 38 Centrifugal
- ☐ 39 Diaphragm
- ☐ 40 Piston

IX POWER UNIT: (Independent)
- ☐ 41 Gasoline
- ☐ 42 Diesel
- ☐ 43 Electric

X ROLLERS:
- ☐ 44 Power (Smooth)
- ☐ 45 Pneumatic Tire
- ☐ 46 Sheepsfoot

XI TRACTORS:
- ☐ 47 Crawler
- ☐ 48 Rubber Tired

XII TRACTOR EQUIPMENT:
- ☐ 49 Bulldozers
- ☐ 50 Power Control Units
- ☐ 51 Rippers
- ☐ 52 Scrapers, tractor drawn
- ☐ 53 Scrapers, self-powered

XIII BUCKETS:
- ☐ 54 Clamshell
- ☐ 55 Concrete
- ☐ 56 Dragline
- ☐ 57 Orange Peel

XIV SHOVELS AND DRAGLINE:
- ☐ 58 Crawler (under 1 yd.)
- ☐ 59 Crawler (1 yd. up)
- ☐ 60 Truck Mounted

XV ROCK DRILLS, AIR TOOLS:
- ☐ 61 Air Compressors
- ☐ 62 Backfill Tampers
- ☐ 63 Clay Diggers
- ☐ 64 Concrete Vibrators
- ☐ 65 Drills, cable tool
- ☐ 66 Drills, tripod and wagon
- ☐ 67 Drills, rock, hand-held
- ☐ 68 Paint Sprayers
- ☐ 69 Paving Breakers
- ☐ 70 Riveters and Chippers

XVI MISCELLANEOUS:
- ☐ 71 Buildings, portable
- ☐ 72 Earth Drills, power
- ☐ 73 Light Plants
- ☐ 74 Lubrication, Service
- ☐ 75 Mowers, Highway
- ☐ 76 Power Saws
- ☐ 77 Soil Stabilizing Equipment
- ☐ 78 Spreaders, sand
- ☐ 79 Street Flushers
- ☐ 80 Street Sweepers
- ☐ 81 Welders
- ☐ 82 Cutting Torches
- ☐ 83 Hydraulic Jacks
- ☐ 84 Hydraulic Control Equipment
- ☐ 85 Hand Tools
- ☐ 86 Hoists, derrick type
- ☐ 87 Highway Guard
- ☐ 88 Snowplows, rotary
- ☐ 89 Snowplows, v or wing
- ☐ 228 Salt

Use This Coupon

Other products not named above, or specific variety of the products checked .....

Your name ..... Title or Profession .....

Name of your company or governmental dept. .....

Type of work for which equipment will be used .....

Street Address .....

City ..... State ..... County .....

QUICK HELP FOR YOU TODAY!

Let Roads and Streets help you efficiently, economically, quickly.

Save your time, your secretary's time, stationery and postage by letting us handle your information needs.

FIRST, fill in your name, title, company or government department, street address, city and state at the top of the card.

•

THEN—

A If you want information about any of the products advertised in this issue of Roads and Streets, enter the advertisements' page numbers and advertisers' names in section A of the card.

•

B If you want more facts about any of the new equipment or the trade literature described in this issue, circle the proper numbers in section B of the card.

•

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IT'S as simple as ABC—fast, dependable, and without obligation on your part.

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3-60-R5

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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A NEW LEAF FOR YOU TO TURN OVER!

Right Now!

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 52, Sec. 510, P. L. & R., Chicago, Ill.

ROADS AND STREETS

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22 WEST MAPLE STREET

CHICAGO 10, ILLINOIS

On the reverse side of this sheet is an opportunity for you to get **quickly, efficiently** and **economically** all the information you may need about:

A Products advertised in this issue of Roads and Streets,

B New equipment described in it or new trade literature mentioned, or

C Any other products—machinery, equipment, materials or supplies—that may interest you. A suggestive list—specially compiled and arranged for your convenience—appears on the next preceding left-hand page. Consult it.

The Readers' Service Department of Roads and Streets is ready to help you now or at any other time, and as frequently as your needs may require. Do not hesitate to make full use of it; you will not be obligated in any way.

So, turn this leaf now and let us start helping you today.

Readers' Service Dept.
ROADS AND STREETS
22 West Maple Street
Chicago 10, Illinois

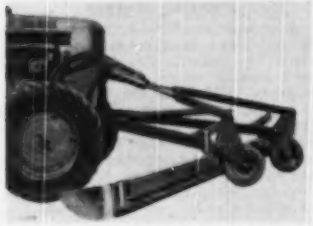
(Continued from page 76)

from an S.A.E. flange-type magneto mounting pad. Delivery is 5 gpm at 1000 psi and 1800 rpm, and permits intermittent pressure of 1500 psi. Uses any light, petroleum base, oil. Ports are tapped for standard pipe thread, ½-inch NPT inlet and ⅜-inch NPT outlet. Direction of rotation for described pump is clockwise viewing drive end. CCW rotation optional.

73

Grader Attachment Eliminates Windrows

Another accessory unit developed to increase the utility of the new Model D motor grader of the Tractor Division, Allis-Chalmers Mfg. Co., Milwaukee, Wis., is an hydraulically controlled windrow eliminator manufactured by the Tractomotive Corporation of Deerfield, Ill. On shoulder maintenance jobs, for example, the windrow eliminator or trailing blade will clear off the excess material which the grader moldboard usually piles up along the road's edge. Constant control is easily maintained because the eliminator rides on its own wheels, and blade settings are not affected by up and down movement of the grader. The unit is easily mounted on the grader frame by four heavy bolts and two 1½ in. pins—no welding or cutting necessary. Complete assembly by two men can be accomplished in less than three hours.

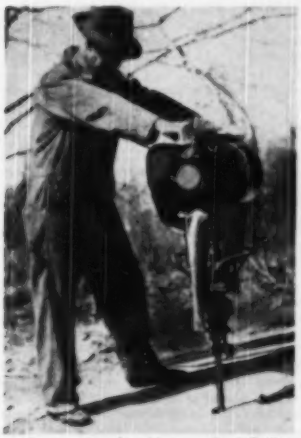


Windrow Eliminator Attachment

74

Gasoline Hammer Rock Drill

A new self-rotating, hole cleaning gasoline hammer rock drill has been added to its line by Syntron Co., 384 Lexing-



Syntron Gasoline Hammer Rock Drill

IT'S A "HUMDINGER" FOR BRIDGE DECKS • MUNICIPAL PAVING • HIGHWAY WIDENING

MODEL M-1 POWER PLANT
Capacity 1.25 KVA. Other plants of 2.5 and 5 KVA. All have permanent magnet generators requiring no adjustment or maintenance. All generate both single phase and 3 phase 60 cycle, 110 volt AC.

JACKSON PAVING UNIT

It consists of a manually guided, electric vibratory paving machine and portable power plant and will place upward of 65 cu. yds. of stiff mix concrete per hour; will undercut at side forms and curbs; strike off to crown (both regular and inverted;) roll back for second passes. Works right up to and around sewers, manholes and other obstructions. Quickly adaptable to any slab width from 6' up to any practical width. Has strong tendency to propel itself. Operators work from front, side or rear. Power Plant generates both single and 3-phase 60 cycle AC and may also be used for lights and operating other contractor's tools. Write for complete details.*

AND FOR THE FASTEST, handiest means of thoroughly compacting granular soils, investigate

THE JACKSON VIBRATORY SOIL COMPACTOR

This machine can be used to tremendous advantage in compacting granular backfill under factory floors, in trenches, bridge approaches, close to bridge abutments, alongside foundations, under footings, ramps, sidewalks, municipal pavements, loading docks; in compacting such granular soil as is used in earth fill dam construction and many other places. Delivers up to 4500 ½-ton vibratory blows per minute. Propels itself at 6' to 8' per min. One man can guide two units side by side. The Jackson M-1 Power Plant will operate two of these machines simultaneously. Complete details on request.*

OTHER MONEY-MAKING VIBRATORY EQUIPMENT

for vibrating full slab widths of highway and airport paving; Side Form vibrators for attachment to finishers and spreaders; mass and general construction vibrators ideally suited to each type of job.

*FOR SALE OR RENT at Jackson Distributors.

Write for the handy **JACKSON "POCKET GUIDE"** describing the complete line.

ELECTRIC TAMPER AND EQUIPMENT CO. • LUDINGTON, MICH.

The Ninth of a Series in the interest of more efficient use of steel . . . a vital American resource

LACLEDE MULTI-RIB REINFORCING BARS

NOW . . . Available by Number in Standard Sizes of New A.S.T.M. Serial Designation A305-49 Table I

Thanks to A. S. T. M. specification A305-49, designers now have a more efficient bar for concrete reinforcement . . . one that provides increased anchorage which when properly used will give appreciable savings in steel and concrete. Advanced design Laclede Multi-Rib Reinforcing Bars exceed the A305-49 specification. They are available in uniform round sections in all standard sizes and can now be ordered by number.

TABLE I A.S.T.M. SERIAL DESIGNATION A305-49

Dimensional Requirements for Deformed Steel Bars for Concrete Reinforcement

Bar No.*	Unit Wt. Lbs./Ft.	NOMINAL DIMENSIONS ROUND SECTIONS: Diameter-Inches Decimal	Cross Sectional Area Sq. Inches	Perimeter	REQUIREMENTS OF DEFORMATIONS: Max. Avg. Spacing Inches	Min. Height Inches	Max. Gap. Inches ‡
3	0.376	.375	0.11	1.178	0.262	0.015	0.143
4	0.668	.500	0.20	1.571	0.350	0.020	0.191
5	1.043	.625	0.31	1.963	0.437	0.028	0.239
6	1.502	.750	0.44	2.356	0.525	0.038	0.286
7	2.044	.875	0.60	2.749	0.612	0.044	0.334
8	2.670	1.000	0.79	3.142	0.700	0.050	0.383
9*	3.400	1.128	1.00	3.544	0.790	0.056	0.431
10*	4.303	1.270	1.27	3.990	0.889	0.064	0.487
11*	5.313	1.410	1.56	4.430	0.987	0.071	0.540

*These sections have the same weight and area as bars formerly known as 1" Sq., 1⅛" Sq. and 1¼" Sq.
‡Chord of 12½% of Nom. Perimeter.
*Bar numbers are based on number of ⅛" included in the nominal diameter of the bar section.

— Write us —

About specifying LACLEDE MULTI-RIB BARS on your jobs

LACLEDE STEEL COMPANY
St. Louis, Mo.

ELECTRIC WHEELS

Designed to do the Job

Wheels and Axles are our business, and our engineers are well qualified to recommend the most efficient assembly for your product.

Our factory is modern and tooled for low cost production. We have supplied manufacturers in many different industries for more than 50 years.

Standard or Special, ELECTRIC Spoke-type or Disc Wheels are built for most types of portable equipment.

Send us your specifications and we will submit our recommendations.

ELECTRIC WHEEL CO., 2912 Pine, Quincy, Ill.

ton Ave., Homer City, Pa. This new rock drill utilizes practically the same principle of operation as the Sytron paving breaker—a single cylinder engine driving two pistons, one piston actuating the flywheel magneto and cooling fan and the other piston, actuated by explosive force, striking directly on the shank of the drill steel. The rotation of the hollow drill steel and bit is accomplished by the orthodox method of using a spirally splined piston and ratchet. Exhaust gas is forced through the hollow drill steel to blow the cuttings out of the hole, down to a depth of approximately 24 in. For deep hole drilling—down to 8 or 10 ft.—an extremely small, light-weight, auxiliary gas engine-driven blower is hose connected to the hammer to boost the pressure through the hollow drill steel.

75
Straightening Bent Parking Meters

A special attachment to the Coffing Hoist-All, now being produced by Coffing Hoist Co., Danville, Ill., straightens out bent parking meters right in the concrete in which they are imbedded. By means of this special collar and chain arrangement used with the Hoist-All, which can also be used for pulling out meter pipes and many other purposes in any community, any bent parking meter post can be straightened out in a couple of minutes with a minimum of effort.

MANUFACTURERS' LITERATURE

76
Self-Powered Sidewalk Paver

Bulletin 50 just issued by Dotmar Industries, Inc., 503 Hanselman, Kalamazoo, Mich., describes the Dotmar paver for laying integral gutter, curb and sidewalks, or sidewalks alone, up to 78 in. wide. Many on-the-job pictures are shown, various types of available screeds and trowels are described and complete specifications are given.

77
New Type Vibrating Screen

A new type of highspeed, non-blinding vibrating screen for handling damp, sticky materials such as agricultural limestone is described in a 4-page folder released by the Deister Machine Co., Fort Wayne, Ind. The new screen embodies a number of new developments in screening, including higher speeds, longer stroke, steeper angle, and a graduated stroke. An exclusive feature also is "unitized" head-motion, in which the vibrating mechanism is precision-built and jig-assembled to permit interchangeability as a complete unit in a matter of a few minutes.

78
Vibrating Screens

A guide to the selection of vibrating screens for every type of sizing and scalping operation is included in a 20-page booklet, released by Deister Machine Co., Fort Wayne, Ind. The booklet contains a section of actual photographs and working information on screen sizes, production capacity and service for a wide variety of applications such as sand, gravel, stone, coal, haydite and hot mix asphalt.

79
Compressors

A new catalog on Joy Unitair compressors, now available from the Joy Manufacturing Company, Henry W. Oliver Bldg., Pittsburgh 22, Pa., is profusely illustrated with pictures of all sizes of the Joy WL-80 compressor as well as sectionalized drawings to point out its various features. An interesting part of this catalog is a "Selector Chart" which makes it possible to choose a compressor according to individual requirements.

80
Traffic Paint

A traffic line marking paint that combines quick drying and long wear is described in a circular issued by the Baltimore Paint and Color Works, 150 S. Calverton Road, Baltimore 23, Md. It is stated that 10 minutes after application under normal traffic conditions the paint is ready for resumption of traffic flow. The paint is made by an entirely new principle, involving radically new synthetic materials.

81
Engines on Construction Jobs

Prepared for the construction trade is a recent publication by Caterpillar Tractor Co., Peoria 8, Ill., entitled "Cat" Engines on the Construction Job. The eight-page illustrated booklet discusses power requirements for excavators, compressors, electric equipment, pumps, ditchers, rollers, and movable forms. Specifications on a complete line of "Caterpillar" Diesel Engines are included in this informative booklet.

82
General Purpose Hoists

Two new catalogs issued by American Hoist & Derrick Co., St. Paul, Minn., cover the line of American general purpose hoists. Both catalogs are profusely illustrated with operating pictures as well as illustrations of mechanical parts and assemblies. Catalog No. 100-H-40 covers American general purpose hoists from 5 to 40 h.p. Catalog No. 100-H-55 covers American hoists from 50 to 100 h.p.

83
Data on Safety Equipment

The 1950 issue of "Everything in Safety," a catalogue of personal protective equipment and industrial safety devices, has been released by the General Scientific Equipment Co., 2700 W. Huntingdon St., Philadelphia 32, Pa. This new catalogue covers, respiratory devices, eye protection, hats, gloves, carboy pumps, drum pumps and miscellaneous industrial safety equipment for use in industries, mines, utilities, and farms. It is 46 pages, fully illustrated, and includes price list.

84
Steel Bridge Flooring System

A new structural plate steel bridge flooring system is described in a 4-page technical bulletin published by United Steel Fabricators, Inc., Wooster, O. Lightweight and quick to install, USF structural plate bridge flooring is recommended for bituminous surfaced roadways on bridges, viaducts, overpasses and similar structures. Along with photographs of a highway bridge in various stages of construction, the bulletin includes a complete engineering description and a drawing which details all component parts. Also listed in the bulletin are design data for H20 loading and complete specifications.

NEW GIANT ALLOY
adjustable wrenches
OTC
REPLACE 29 SIZES
THINNER • LIGHTER
STRONGER
Now for the first time quality, light-weight, alloy steel adjustable wrenches drop-forged to stand up under heavy duty jobs. The OTC Slim Twins make tough jobs easy-save tool and time costs - result in faster, more productive work in your shop or on emergency calls. The OTC Slim Twin Wrenches replace 29 standard size wrenches.
OA-24 is 24" long, 7/8" thick and weighs only 10 lbs. Adjusts to 13 standard sizes from 1-3/8" to 3-7/8".
OA-36 is 35" long, 1-1/8" thick and weighs only 22 lbs. Adjusts to 16 standard sizes from 2-15/16" to 4-3/4".
EXCLUSIVE DESIGN GIVES ADDED STRENGTH IN PROPERLY LOCATED LEVERAGE POINTS.
PATENT APPLIED FOR
OTC
OWATONNA TOOL COMPANY
431 CEDAR STREET, OWATONNA, MINN.

SAUERMAN
FOR FAST MATERIAL HANDLING AT LOWEST COST
RAPID-SHIFTING DRAG SCRAPER MACHINES
Greater speed, efficiency and economy are provided by this new series of drag scrapers for cut-and-fill—excavating hard-packed materials from banks or pits—strip mining—many other uses.
Operator at scraper hoist has AUTOMATIC CONTROL of shifting tail end of machine, and instant spotting of scraper bucket wherever he wishes. Sizes from ⅓ to 4 cu. yds. Gasoline, electric, or diesel 3-drum roller-bearing hoist furnished with each machine. Send details and we will be glad to advise on your own project. Catalog on request.
SAUERMAN Rapid-Shifting Scraper in the above picture is cutting into a hill and moving material to a fill 400 ft. away. The 4 cu. yd. machine digs and places 2,000 cu. yd. a day. Shifting of the path of the scraper is facilitated by means of an elevated tail bridle set up on the brow of the hill, from which a shifting cable runs to the front drum of the 3-drum scraper hoist.
SAUERMAN BROS., INC.
560 S. CLINTON ST., CHICAGO 7, ILL.
Long Range Material Handling Machines

85
Crushing and Screening Plants

A new 20 page booklet covering its complete line of portable combination 2-Unit crushing and screening plants issued by Pioneer Engineering Works, Minneapolis 13, Minn., covers primary and secondary rock and gravel plants, featuring the portability and versatility of the plants to meet the varying conditions for aggregate production. Complete specifications are given, together with a guide to proper selection of equipment. A full cut-away view of two typical plants shows the flow of material through the units and explains the exclusive Pioneer feature of split feed.

86
Crushing and Screening Plant

A 4-page bulletin describing a new Cedarapids crushing and screening plant has been issued by Iowa Manufacturing Co., Cedar Rapids, Iowa. The simple design features and construction with Cedarapids standard units, which make possible the plant's low initial cost, are illustrated by means of a diagramatic flow sheet. The principle of operation is fully described, and complete specifications and dimensions are given.

87
Patrol Graders

The Trojan Welterweight Patrol is illustrated and described in an 8-page bulletin issued by Contractors Machinery Co., Inc., Batavia, N. Y. Accessories for use with the grader are also illustrated and described. Illustrations are shown of various jobs being handled by the machine. A detail drawing points out the various features of the grader. Specifications are included in the bulletin.

88
Wagon Drills

A bulletin (H-1200-B36A) describing Worthington wagon drills has been issued by Worthington Pump and Machinery Corporation, Construction Equipment Sales Division, Holyoke, Mass. This 16-page, illustrated bulletin describes three models: UMW-40 equipped with a 4 in. cylinder bore; UMW-35 equipped with a 3½ in. cylinder bore; and UMW-30 with a 3 in. cylinder bore. The wagon wheel base of each model is 6 ft. 3 in.

89
Electric Plants

Two folders issued by D. W. Onan & Sons, Inc., Minneapolis, Minn., cover the complete line of Onan electric plants. An 8-page folder is devoted to the gasoline-driven electric plants, ranging from 250 watts to 35,000 watts, in all standard voltages, frequencies and phases. A 4-page folder covers diesel-driven electric generating plants. Models range from single cylinder, 2,500 watt air-cooled units to 6-cylinder 60,000 watt water cooled plants.

90
Sectional Conveyor

An illustrated description of the recently introduced Hewitt-Robins sectional conveyor is given in a new bulletin issued by the Robins Conveyor Division of Hewitt-Robins, Inc., Passaic, N. J. This unit, easily assembled in the field, consists of a head (drive) section, a tail section and any desired number of intermediate truss sections to form a conveyor of any length up to limitations of the belt.

91
Buckets

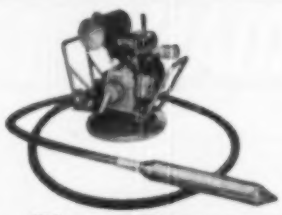
Baer shovel, dragline and hoe buckets are illustrated and described in a folder issued by Baer Steel Products, Inc., Auburn, Wash. Front castings and teeth are Fibraloy, stated to be the toughest steel known. Claims for these buckets include the following: Proper pitch (front cutting angle) provide fast digging; true tapes (front to rear) allows fast loading and quick dumping; full fairing (round corners) makes for clean scouring; bucket balance (at trunion) assures easy handling and positive dumping.

92
Truck-Mounted Shovel Crane

A catalog just issued by Link-Belt Speeder Corporation, Cedar Rapids, Ia., contains applications, construction details, customer benefits and specifications of the new HC-51 truck-mounted shovel-crane with Speed-o-Matic hydraulic controls. Paramount features of the HC-51 are fully hydraulic Speed-o-Matic controls, front drum reversing mechanism for power control load lowering (particularly advantageous for steel erection) and a heavy duty carrier specifically designed for truck-crane operation.

93
Power Hydraulic Control

The Monarch Hy-Lo-Jack power hydraulic control for snow plows, truck and tractor equipment is illustrated and described in a folder issued by Monarch Road Machinery Co., Grand Rapids, Mich. This is a complete power hydraulic control kit, that is easy to install and is built for rugged service. It has a one lever cab control.



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DEPENDABLE FLEXIBLE DRIVE. All sections are interchangeable, in multiples of 7' and 12' lengths. No special sections are required. Each casing has ball bearing connector. Each alloy steel core has slip joint which does not separate in service. It prevents stretching and overheating. No limit to length of drive.

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CONCRETE GRINDERS. Speed reducing heads, to hold wheels, can be attached to any drive section.

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Elkhart White Mfg. Co. Indiana

NEW TORO HIGHWAY MOWER CUTS MOWING TIME IN HALF

Sickle driven by *independent engine* gives constant cutting speed regardless of tractor's traveling speed

The new Toro "Roadmaster" cuts weeds, brush and saplings which are impossible to cut with conventional "power take-off" mowers. Its independently powered sickle maintains a constant cutting speed . . . shears through growth up to 2½" . . . does a much cleaner job in half the time!

This low-slung tractor sticks on slopes steeper than 35° . . . mows over curbs from 1½" to 10" high . . . travels up to 48 m.p.h. between jobs. Fast acting hydraulic lift controls sickle at angles from 45° down to 90° up.

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2085 Snelling Avenue, Minneapolis 6, Minnesota

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We Invite You to Investigate the Price And Quality of These Shovels

1—NORTHWEST SHOVEL, Model 80D, 2½ Cu. Yd., Serial No. 6873 with Murphy 6 cyl. diesel engine, Kohler Light Plant, reflectors with 37' 6" Boom, 28' Stick, 1¾ Cu. Yd. Dipper. Also have std. front with 2½ Cu. Yd. Dipper. Year 1946.

1—NORTHWEST SHOVEL, Model 80-D, 2½ Cu. Yd., Serial No. 12505 with Murphy 6 cyl. diesel engine, Kohler Light Plant, reflectors with 27'6" Boom, 22' 6" Sticks, 4 Cu. Yd. Coal Loading Bucket or 2½ Cu. Yd. Digging Bucket. Year 1947.

1—NORTHWEST SHOVEL, Model 70, 1¾ Cu. Yd., Serial No. 5768 with Murphy 6 cyl. diesel engine, Kohler Light Plant, reflectors with 33' Boom, 28' Sticks, 1¾ Cu. Yd. Dipper. Year 1939.

1—BUCYRUS ERIE SHOVEL, Model 54-B, 2 Cu. Yd., Serial No. 41559 with Buda Lanova Diesel Engine, 45' Boom, 32' Stick, Kohler Light, Year 1945.

1—LIMA SHOVEL, Model 1201, 2½ Cu. Yd., Serial 5313 High Lift Shovel, 42' Boom, 32' Stick, 1500 Watt Kohler Light Plant, Cummins Diesel Motor Type L. Year 1948.

1—MARION SHOVEL, Model 151-M, 6 Cu. Yd., Serial 8431, Electric Shovel 3/6/2300-4000 volts, with 38' Boom, 32' Stick. Also 45' Boom, 32' Stick and 5 Cu. Yd. Bucket, Year 1946.

1—LORAIN SHOVEL, Model 830, 2 Cu. Yd., Serial No. 15766, with Caterpillar D-13000 Engine with Kohler Light Plant, 23' Boom, 18' Stick, with 3 Cu. Yd. Coal Loader or Standard 2 Cu. Yd. Dipper. Year 1947.

1—NORTHWEST SHOVEL, Model 6, 1½ Cu. Yd., Serial 12699, with Murphy 6 cyl. diesel engine, Kohler Light Plant, reflectors, with 25' Boom, 24' Sticks, 1¼ Cu. Yd. Bucket, Year 1947.

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94

Self-Contained Steam Boilers

The advantages of self-contained, oil and gas fired steam boilers for processing and heating are pointed out in a new catalog published by Cleaver-Brooks Co., Milwaukee, Wis. Illustrated are various sizes of steam boilers, ranging from a 15 to 500 H.P. and 15 to 200 P.S.I. Included in the catalog is a diagramatic cross-section illustration representative of the four pass design found in Cleaver-Brooks boilers. Oil fired, gas fired and combination oil and gas fired boilers are shown.

95

Heavy Duty Loader

The new self-propelled, self-feed, belt-type Adams Traveloader is featured in an 8-page catalog issued by J. D. Adams Manufacturing Co., Indianapolis, Ind. This machine has a full-floating feeder that automatically adjusts itself to sizes of windrow, an adjustable conveyor to accommodate all trucks, a compact heavy-duty drive unit and positive and convenient controls. All these features are illustrated and described in the catalog. Specifications also are included. Illustrations of typical operations of the Traveloader are shown.

96

Arc Welding Machines

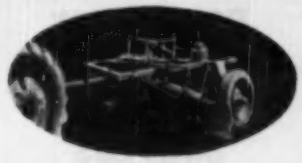
A new arc welding machine catalog, the first to include all the machines in the Airco line, has been announced by Air Reduction Sales Co., a Division of Air Reduction Co., Incorporated, New York, N. Y. The 36-page, illustrated catalog, the fourth of a projected series of ten, is divided in two parts, the first dealing with AC arc welders, the second with DC machines. The descriptive text gives distinctive features, operating data, specifications and other pertinent information about each machine.

97

Diesel Engines

Complete specifications for automotive and industrial models of two V-type, 12-cylinder Cummins diesels, the supercharged 550 h.p. (maximum) NVHS engine and the naturally aspirated 400 h.p. (maximum) NVH engine, are contained in two bulletins announced by the Cummins Engine Co., Inc., Columbus, Ind. The bulletins contain installation drawings, photographs, and charts on torque, horsepower and fuel consumption, in addition to general specifications for standard equipment.

THE YORK RAKE



Redistributes the windrow left by a Grader Blade and, simultaneously, "screens" the oversize stones, carrying them to the side of the road, leaving a perfect driving surface.

Is valuable for roadside improvement and landscaping—levels the surface—rakes the stones into a windrow so they may be easily picked up—leaves a perfect seed bed.

Is adapted for use behind Power or Drawn Graders, light Tractors or Trucks.
Saves time and labor.

For full information write

YORK MODERN CORP.
UNADILLA, N. Y.

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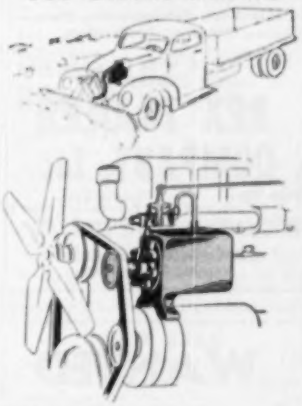

- Thousands in use.
- Fit all trucks.
- Fan belt or electrically driven models.

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2—D4 Caterpillar Tractors with Hyster Winch $4,750
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3—1½-2 LaPlante Choate, airborne scrapers $875
5—D7 Caterpillar Diesel w/DDPCU, Cable Blades, new guarantee $11,500
1—HD 10 Allis-Chalmers, Bare $6,500
2—TD 18 International Diesel, Bare $7,000
1—TR 18 Internat'l Diesel, Hydraulic Blade $9,500
3—TD 14 International Diesel w/ Hughes Kansas Crane $4,500
1—D8 Caterpillar Diesel DDPCU, Cable Blade, Low Hours $11,500
1—Lorraine BIC 40-50 Ton-Motor Truck Crane, mounted on 10 pneumatic 12.00 x 20 tires, 45 ft. Boom $17,500
2—Adams Patrol Graders, Mdl. 511 Diesel $4,750
1—Adams Patrol Grader, Mdl. 411 Diesel $4,500
1—P&H Model 150 Crawler Crane, compl. w/ Shovel, Dk, Hoe $6,500
1—Koig 1-1 Ton Tandem Roller $2,750
2—Gilbert Motel Krane Kars, Model AY-10 ton $5,750
1—Gilbert Motel Krane Kar, Model AX-5 ton $4,000
2—Cranemaster Pneumatic Rear Tires—6 ton $1,750
1—Hyster Carry Crane, 5 ton $2,750
1—Hyster Straddle Truck, 12,000 lb. capacity $2,750
2—Towmotor 5 ton LT 72 Fork Trucks $2,750
1—New Le Roi Tractair 100 Cu. Ft. $2,750
1—Ingersoll Rand Diesel, 2 stage trlr. mtd., 105 cfm $1,850
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2—D8 Caterpillar tractors, 8R series, in excellent condition with 2—C104 LaPlante Choate scrapers, 26 yd. struck 33 yd heaped, in excellent condition with tires 80 to 85% new. Or will furnish above scrapers with 2 new D-8 tractors and one 8R series D-8 pusher. Located N.Y. State.

1—80D Northwest Shovel 2½ yd serial 28724, with Murphy Diesel. Excellent condition throughout. Located near Hardwick, Vermont.

1—1201 Lima Crane and Shovel, Serial 21289. Has new 3½ yd. shovel front, fairleads, 110 ft. boom, light plant, 3 sheave hook block, and misc. parts. Machine has had very little use. No stripping or rock use. Located in Syracuse, N.Y.

1—No. 6 Northwest Crane and Shovel, 1½ yd. shovel, 55 ft. crane boom, 1¾ yd. drag line bucket, 1½ yd. clam shell bucket. Twin City gas engine. Machine in good condition. Cheap. Located Hardwick, Vermont.

4—Euclids, bottom dump, 13-17 yd. Cummins diesel. Good condition. Tires good.

A. L. DOUGHERTY CO.

Guaranty Bldg. Indianapolis, Ind.
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1—Model D7M Caterpillar tractor W/D/D/P/C/U & Le Tourneau Dozer extra good condition $5,750.00

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1—Caterpillar Model 66-wheel grader extra good condition $750.00

1—Ingersoll-Rand 105 air compressor new condition $1,350.00

1—Model 11S Smith concrete mixer extra good condition, wheelbarrow, buggies, scales, water tanks, pumps, vibrator, saw rig, complete outfit, $2,750.00.

All equipment located near
Kaufman, Texas

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Shovel Trout comp. 3000A Manitowoc
Buckeye C-15 lateral type Trencher. A-1 condition.
P & H lateral type Trencher in fair running condition. Model 1030—12' x 48" digging depth.
Cleveland Model 110 manufactured 1947.
Buckeye Model 410 manufactured 1946.
Parsons Model 210 lateral type diesel motor.
Austin Model 105.
Parsons Model 21
Buckeye ¾-yd. Shovel manufactured 1947.
Osgood Model 200 Shovel, serial No. 3175.
Osgood Model 200 Crane with 39" magnet complete.
3-wheel, 10-ton diesel Huber Roller. Like new.
Garwood Scraper, model 515, 16 yds.
Bucyrus-Erie, Model 152, 16 yds. Good condition.
Bucyrus-Erie, Model S-67, 8 yds. A-1 condition.
Model 12 Buckeye Trencher. Like new.

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Diggers only or complete units for sale, for rent, for hire. We contract to dig holes 2" to 24" diameter— 5' to 18' deep. We travel any place, including Canada, Mexico, and South America. We also dynamite drainage ditches and straighten streams to conserve soil. Reasonable rates. Truck and tractor units ready to go. For fast action, write, wire, call

Atom Mfg. Co. **Moline, Illinois**

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Caterpillar No. 12 Patrol. 100 horse engine. Serial number 8T series.

BROWN BROTHERS CONSTRUCTION
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FOR SALE

1 — HYSTAWAY CRANE and Dragline Attachment for Caterpillar D-7 Tractor. Complete with Tagline and Esco one-half cubic yard dragline buckets. Practically new—Used about 50 hours.

CHAUTAUQUA COUNTY
of Highways
FALCONER, N. Y.

WANTED

2 yd. Stationary Concrete Mixer; electric power; bath hopper; Eastern location preferred. Send complete description, condition.

Write Box 1032, Roads & Streets
22 W. Maple Street, Chicago 10, Ill.

FOR SALE

1—Austin-Western portable 20 x 36 primary crushing unit
1—Manitowoc 1½ yard shovel, model 2000B
1—Complete gravel washing plant, portable
1—36 x 40 Dixie Hammermill equipped with Murphy diesel, portable
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1—Universal 8 x 80 gravel plant, 2 years old
1—Austin-Western 40 x 22 roll crusher
1—P&H ¾ yard dragline
2—Dixie Hammermill
1—Complete rock crushing plant, including crushers, hammermill, shovels, air compressors, generating plant and scale.

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Equipment & Supply Co.

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ALL LATE MODELS

1—Allis-Chalmers Tractor
1—Caterpillar Auto Patrol
5—DW 10's—3000 hrs. or less
1—Caterpillar D8—Angledozer
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Surges, Bins, Feeders, Boilers, Coliseums, Cars, Conveyors, Conveyors, Cranes, Dryers, Elevators, Elevators, Engines, Generators, Heads, Kilns, Draglines, Oreg Scrapers, Dredges, Drills, Engines, Loaders, Motors, Pumps, Rails, Rollers, Scales, Screens, Shafting, Shovels, Tanks, Trestles, Trucks, Etc. to many other types and classifications of equipment in the United States and Canada. What you need may be near your plants.)

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"Caterpillar" Model 4600 engine in good condition can be used in a "Caterpillar" Model 6 tractor, grader Model 10 dirt wagon, Lima or Northwest shovel. Priced right.

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—With 14,000-Lb. "Eaton" 2-Speed Axle Assembly, With Heavy-Duty Frame Section, Springs, Etc.

Adaptable to almost any make or model, long wheel-base truck (4½ Y. or over). For Farm or industrial bulk hauling. Ideal for independent dump-trailer units. An $1,600 value!

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(1) Nordberg, Symons screen, 5' x 16' single deck.

(1) Nordberg, Symons screen, 4 x 12" D. Deck.

Several F. B. Morse, Byron Jackson, Pamona, deep well pumps in various capacities.

Stock of new and rebuilt AC and DC motors, hoists, pumps, transformers and miscellaneous items.

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3—40" Telsmith Gyratory Crushers
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1—36 Champion Jaw Crusher
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1—¾-yd. P & H Shovel
1—1½-yd. Northwest Shovel
1—10-ton Harculas Diesel Three-wheel Roller
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1000' of 6½" ID 7" OD Steel Pipe

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Steam Pile Hammers and Extractors
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301 Buckeye Ditcher—excellent condition
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Locomotive Crane, 20 Ton Brownhoist, 8 wheel, 50 ft. boom.
Double drum hoist, belt driven, "American"
Shovel attachment complete for Koehring Crane 301
Blade grader, "Russell" 12 ft. blade, pull type.
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FOR SALE

Model 9-W Bucyrus-Erie electric dragline; 200' boom; 8-c.y. bucket; individually driven, regenerative drum sets. Machine like new. Pennsylvania location.

120-B Bucyrus-Erie shovel, with standard boom and sticks and 4-c.y. dipper. In excellent condition. Pennsylvania location.

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80-D Northwest dragline with 70' boom, 2½-c.y. bucket, new Murphy diesel engine. Pennsylvania location.

80-D Northwest dragline with 80' boom, 2½-c.y. bucket, Murphy diesel engine, standard crawlers. Good condition. Pennsylvania location.

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Model 618 Page Dragline with 110 foot boom 5 yard bucket. 3 cylinder 11 x 15 engine. Machine given general overhauling and new walking shaft installed November, 1949. Pennsylvania location.

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1 Buckeye Clipper Dragline like new. General Motor Diesel Power with Bucket $14,500.

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Scraper, 8-12 yd. Le Tourneau, Model "U9," Cable Controlled, 1400 x 20 Tires, Fair Condition **$650.00**

TRACTOR, FORDSON with Mower, Very Good Condition **$900.00**

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1 Colby crane Model 200 Whirley w/125 ft. boom S/N 193. Has trawler wheels and leg extensions for additional height. Electric powered.

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1—Pair Rolls, Allis-Chalmers 40"x15", Anaconda, rebuilt and Rebabbited.
1—No. 6 Traylor Gyratory Crusher with T.Z. head.
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Bucket Elevators, open and totally enclosed, new and used, as is or rebuilt.

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Nos. 6, 1, 2 Vulcan Pile Hammers and Driving Rigs
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All sizes Pile Hammers & Extractors for Rent

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2 Int'l. KR11 Mixer chassis, very clean. Price $2500.00 each.

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Used Barber-Greene Asphalt Plant—Volume Control

20 Ton Per Hour

Barber-Greene Mixer—Serial No. 840-4-1

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B.E. 85-B 3½ Cu. Yd. shovel—electric. N. W. Model 6-1-½ yd.
N.W. Model 90- 2 yd. Lima 120—Cummins Engine—3 Cu. Yd. shovel.
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250 KVA—440 volt G.E. Diesel Driven Generator set like new.
48" Gyrasphere Crusher complete—Gyratory crushers—Roll Crushers.
Jaw Crushers—60" x 42"—24" x 36"—20" x 36"—18" x 36"—15" x 30".
10" x 30"—Complete crushing plant including 42" x 30" Jaw. Others.
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1—8 & W coal pulverizer

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Link Belt pan conveyors 36'x22' centers

Richardson automatic scales

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Fuller-Kinyon pump (6")

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5 Ton ⅝" steel banding tape

Steel dredge boat and tug boat

70 HP Kahlenburg diesel engine

*One industrial plant site.

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TRACTOR—"CATERPILLAR" D6, "4R" Series, with "Caterpiller" straight bulldozer and "Caterpillar" single drum, Front mounted, cable control. Thoroughly reconditioned. $6,000.00.

TRACTOR—2 "CATERPILLAR" DW10, late series, with "Caterpillar" #21 cable controlls and "Caterpillar" #10 scrapers. Has been used slightly over 700 hours. Price $15,000.00 each.

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For all makes draglines, shovels, ditchers, pavers, and other chain drives machinery. Chain size comparative chart on request.

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1—Adams Grader

1—Adnun Paver #1014

1—Hough Loader, 1948, Model HL-A, Serial #3915

3—1945 Mack 9-ton chassis, Model EMX 120 equipped with 1100-20 tires

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1 Cummer hot mix plant complete with 1 ton mixer. Capactiy 25 T.P.H.

1 Cummer 2 fire plant with vibrating screen. Capacity 35-40 T.P.H. Complete with melting kettle, dust collector etc.

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1—Besser K-3 Tamper Block Machine

1—4" attachment

1—6", 8", 10", and 12" attachments also

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3000—12½" x 18" steel pallets

44—42 Block Racks

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1—Shovel front for Michigan Power Shovel

Priced to sell

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"Caterpillar" Diesel Electric Set, 50 KW 3 Phase 50 Cycle 110-220 Volt. Total hours of use 3961. This unit has gone through our shop and is A-1 shape and guaranteed. $4,750.00.

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1—Koehring 105 mixer.
1—Koehring 145 mixer.
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The above equipment in good to excellent condition

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2000 L.F. 9" Road Forms
2400 L.F. 10" Road Forms

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Bucyrus Monighan Model 5-W. Diesel Dragline
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FOR SALE

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8. 1—HD-14 Allis Chalmers with Baker Bulldozer blade also equipped with double drum power take-off for scraper work. Price $7,500.00
9. 1—Three-bag Ransome Mixer on four pneumatic tires, with scales, batch meter and three pneumatic tired Concrete Carts $1,200.00
10. 1—12 yd. Tournapull, Cummins motor, splendid condition. Price $7,500.00

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Contractors' Equipment

1—Byers Model 125 combination shovel & crane $6,000.00
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Unit 1½ yd. dragline
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Universal 8 x 36 crusher
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Universal truck crane
24 x 60 port. belt conveyor

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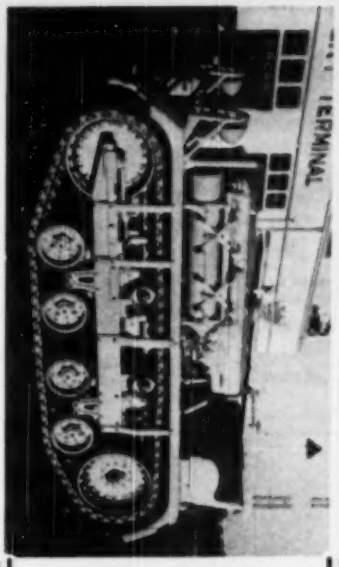

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INDEX TO ADVERTISERS

Aase, Stig 118
Acker Drill Co. 126
Acme Equipment Company, The 34
*Adams Mfg. Co., J. D. 10-11
Adams, R. N. 116
Air Compressor Rental Company 116
Alabama Dry Dock & Shipping Company 116
Allis-Chalmers 6-7
All Purpose Spreader Co. 93
American Chain & Cable Company 28
American Shipbreakers, Inc. 122
*Anthony Company 108
Atom Manufacturing Company 116
*Austin-Western Co. 24

Babcock Equipment Co., Inc. 117-123
Barrett Division 81
Baxor Industrial Sales, Inc. 117
Berkeley Distributors, Inc. 122
Bierman Sales Co. 115
*Bethlehem Steel Co., Inc. 1
Birch & Sons Construction Company, D. 118
Bitkoff Machinery Co. 120
*Blaw-Knox Company 9
Blaw Ball Machine Works 118
Boyle, Morris C. 120
Boyle & Co., M. J. 120
Brown Brothers Construction 116
Bruce, Harry 121
Bryant Products, Jerry 118
Bucyrus-Erie Company 26-27
Burt Equipment & Supply Co., M. C. 117

Carlson Co., Fred 124
Carlson Tractor & Equip. Co. 129
Caterpillar Tractor Co. 8-9
Cemco Mfg. & Supply Company 124
Chaffee, E. L. 121
Chicago Heights Coal Co. 119-124
Clapp, Riley and Hall Company 122
Clark, M. A. 120
*Cleaver-Brooks Company 88
Collignon Construction Co. 120
Colorado Fuel & Iron Corp. 69-70
Consolidated Industries 123
Continental Machinery & Supply Co. 121
Contractors Machinery Co. 118
Crane Company, F. C. 123
Crean, R. J. 122
Cummins Diesel Sales Corp. of Ohio 117
Cummer & Son Co., F. D. 97

D'Angelo & Sons, Inc., A. 123
Dakota Tractor & Equipment Co. 119
Detroit Diesel Engine Division 84
Dietrick, E. P. 117
Diehl Company, R. E. 16
District Sand & Gravel Co. 125
Dougherty Company, A. L. 116
Douglas Fir Plywood Association 108
Drave-Doyle Company 123

Eagle Crusher Co. 106
Eaton Manufacturing Co. 18
Eikeland & Holmgren 120
*Electric Tamper & Equipment Company 111
Electric Wheel Company 112
*Embury Manufacturing Company 16
*Etnyre & Company, E. D. 87
Euclid Road Machinery Company 20

Fabick Tractor Co., John 121
Fike, Virgil 119
Fishel, Al 123
Fobel Vandereester Auto Sales, Bill 110
Flex-Plane Company 108
Foote Company, Inc. 13
Ford Motor Company (Truck) 15
Ford Motor Company (Ind. & Marine Eng. Dept.) 73
Forke Bros., A. Ficke 117
*Frink-Roe Plows, Inc. 103

Gallion Allsteel Body Co., The 108
*Galion Iron Works & Mfg. Co. 21
Ganley, Inc., Howard 121
Gates Company, W. N. 119
Gillespie Equipment Company 122
Goodrich Company, The B. F. 3
Grace Mfg. Co., W. E. 103
Grasky Constructors 118-121

Harnischfeger Corporation 33
Harris Machinery Co. 118
*Helfzel Steel Form & Iron Co. 79
Hensley Truck Parts, Wm. O. 122
Hetherington & Berner 98
Hudson Company, A. E. 122
Hyman-Michaels Company 122
Hyster Company 74

Illinois Road Equipment Company 123
Ingersoll Co., The Chas. M. 125
*International Harvester Company 22-23

Jack, Inc., W. F. 119
Jaeger, Lee 122
Jaeger Machine Company, Inc. 101
Jens, Fred E. 123
Jersey Equipment Company 121
Johnson Co., C. S. 30-31
Johnson & Hoehler, Inc. 118

Keller & Son, L. M. 129
*Kinney Mfg. Company 104
Koehring Company 30-31
Koppers Company, Inc. 80
*Laclede Steel Company 112
Kraemer & Sons, Edward 124
Krucell Inc., J. A. 124
Kwik-Mix Co. 30-31

Lackey, Gordon 122
*Laclede Steel Co. 112
Ladochnins Garage Inc. 128
LaPlant-Choate Mfg. Co. 12
Lawrence, Ollie E. 119
Lima Hamilton Corp. 67
Link-Belt Speeder Corporation 61
Littleford Bros. 17
Louisiana Industrial Equipment Co. 124

Machinery & Supplies Co., Inc. 120
Mack International Motor Truck Corp. 35
Marine Metal & Supply Co. 125
Marmon-Herrington Co., Inc. ..... Third Cover
McCarter Iron Works, Inc. 104
McCarthy Inc., Warren E. 124
McCutchin Construction Corporation 125
McGark, Inc., E. B. 119
McIlvar Construction Company, W. K. 125
McLeod, Alex T. 117
Meagher & Sons, W. J. 119
Meyers Truck Co. 120
Miller Hasselbalch & Company 118
Mississippi Valley Equipment Co. 119-124
Monarch Road Mach. Co. 115

National Boiler & Equipment Company 121
Nieb Concrete Products 119
Northrop Aeroplane Company, Marvin A. 124
Northwest Engineering Company ..... Second Cover
Northwestern Auto Parts Co. 117

Ohio Machinery Company 121
*Ohio Oil Company 78
Ohio Valley Sand Company 122
Ottumwa Sand Company 118
Owatonna Tool Company 115
*Owen Bucket Company 110

Parsons Co. 30-31
Penna. Flexible Metallic Tubing Co. 4
Peoria Tractor & Equipment Co. 119
Perfection Steel Body Company 74
Perini & Sons, Inc., S. 115
Perkins, P. H. 121
Pioneer Engineering Works, Inc. 14
Piper, Elmer 128
Portage-Manley Sand Co. 124
Portland Cement Ass'n. 28

Republic Steel Corp. 32
Rex Tractor Co. 116
*Rogers Bros. Corporation 112
Rogers Cartage Company 120
Royce Inc., Ken 121
Ruemelin Mfg. Company 100

*Sauerman Bros., Inc. 113
*Seaman Motors, Inc. 91
Shunk Mfg. Co. 16
Standard Spring Co. 121
Standard Steel Corporation 104
Sterling Machinery Corp. 124
Stone Manufacturing Company, The 118
Straits Construction Company 117
Swabb Equipment Company, Inc., Frank 118
Sweeney Bros. Tractor Co. 110-121

Tarrant Manufacturing Company 103
Tennant Company, G. H. 100
Texas Company, The ..... 36-Back Cover
*Timken Roller Bearing Company ..... Front Cover
Toro Manufacturing Company 114
Tractor & Equipment Co. 120
Troyer, Stanley E. 119
Turner Chain & Belting Co. 119

Unit Crane & Shovel Company 107
Universal Atlas Cement Company 63
Universal Engr. Corp. 96
Vos Equipment Co. 129
Vosburg Bros. Block Co. 110
Vulcan Tool Company 115

Waller Paving Co. 120
Walsh, J. T. 125
Wamix, Incorporated 124
Waterhouse, Clifford 117
Watson, Emmett C. 120
Wellman Company, S. K. 72
Wellman Engr. Company, The 90
Wenzel Machinery Rental & Sales Co. 124
Western Contractors Supply Co. 123
*White Manufacturing Company 114
Wickwire Spencer Steel Div. 19
Wilensky Auto Parts Company 122
Williams Construction Co. 117
Wing & Son, R. B. 124
York Modern Corporation 115

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